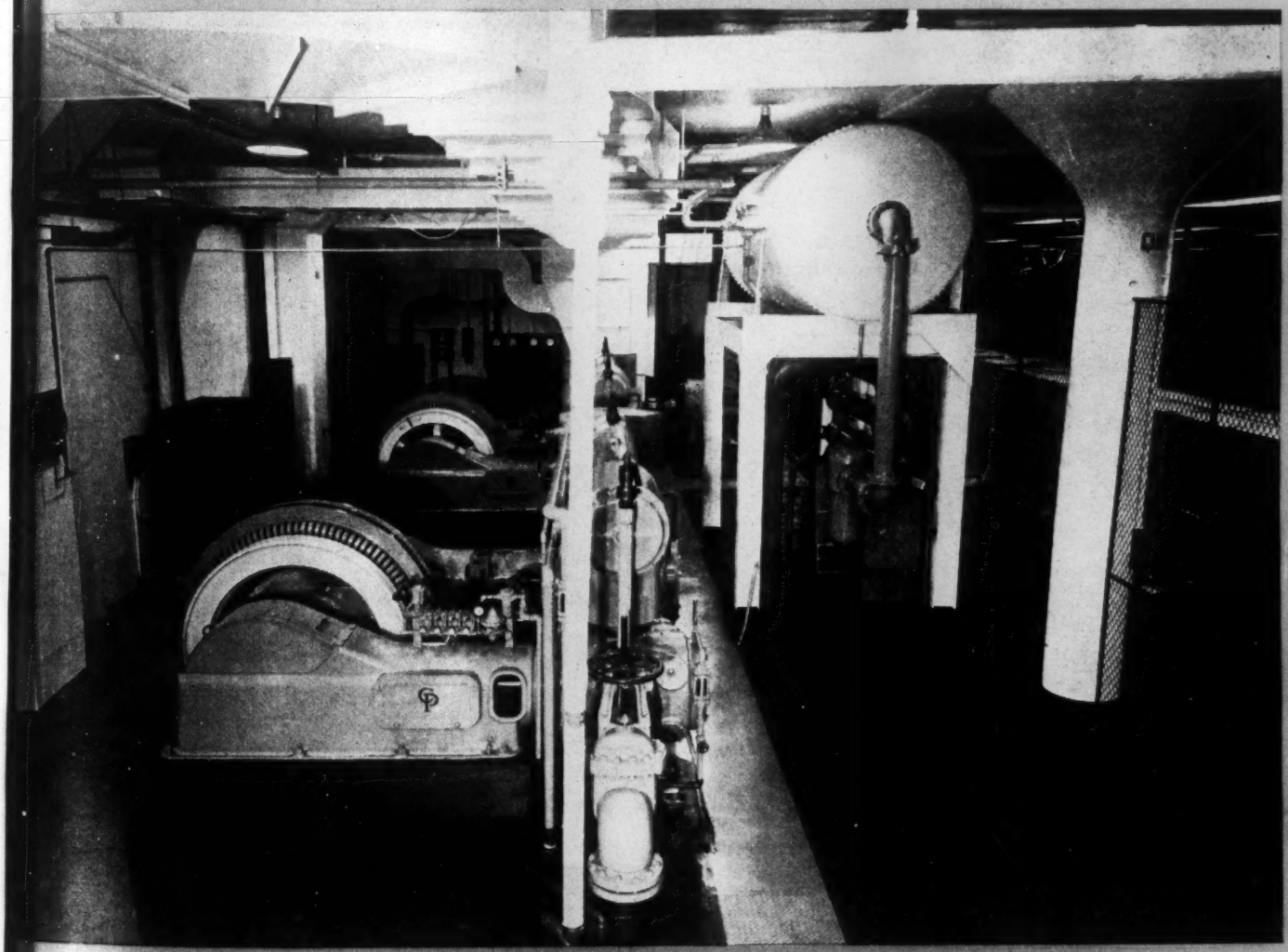
Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

OCTOBER ★ 1948

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

111—Journal Section of the American Society of Heating and Ventilating Engineers



Compressed air piping changes improve plant operations....page 73

to Use Corrosion 77
Office Building Air Conditioning 81
Hospital Heating and Air Conditioning ..89
Complete Contents of This Issue 71

UNIVERSITY OF MICHIGAN LIBRARIES

HOW TO BEAT HIGH FUEL COSTS!

Users of GRINNELL THERMOLIERS report savings up to 35%*

To maintenance men who figure savings in tenths of cents, a saving of up to 35% in heating costs is a windfall in these days of high fuel prices and tight supply.

A Thermolier installation will assure you of proper heat *at the working level,* not banked uselessly near the ceiling, and it will do it at the lowest possible fuel cost. Thermolier's 12 points of superiority make it the best "heat machine" on the market.

Get in touch with Grinnell or your local Thermolier Distributor at once. See for yourself how Thermoliers may effect this kind of savings in your fuel bills.

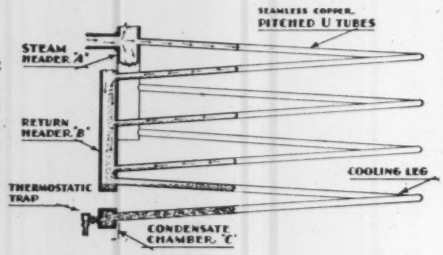
*A Railway and Dock Shop reports savings of 35%.

A well-known manufacturer . . . 29%.

A large manufacturer operating more than 50 plants . . . 30% average.

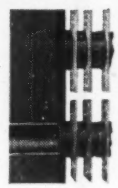
WHAT THERMOLIER'S SUPERIOR FEATURES MEAN TO YOU:

Plain thermostatic trap, the simplest and least expensive kind of trap, made practical because of Thermolier's exclusive internal cooling leg.



Damaging strains caused by expansion and contraction eliminated by "U" type expansion tubes.

Maximum capacity provided at all times and annoying and destructive water hammer eliminated because built-in pitch of the tubes and internal cooling leg assure continuous drainage of condensate.



Safety and durability assured with leak-proof tube-to-header construction.

Additional desirable advantages from eight other features. Write for Thermolier Catalog 6-E.

GRINNELL COMPANY, INC.
Providence 1, R. I.

Branch Warehouses

Atlanta 2, Ga.
Charlotte 1, N. C.
Chicago 9, Ill.
Cleveland 14, O.
Cranston 7, R. I.
Fresno 1, Cal.
Houston 1, Tex.
Kansas City 16, Mo.
Long Beach 10, Cal.
Los Angeles 13, Cal.
Milwaukee 3, Wis.
Minneapolis 15, Minn.
New York 17, N. Y.
Oakland 7, Cal.
Philadelphia 34, Pa.
Sacramento 14, Cal.
St. Louis 10, Mo.
St. Paul, Minn.
San Francisco 7, Cal.
Seattle 1, Wash.
Spokane 15, Wash.

GRINNELL
FOUNDED 1850

WHENEVER **PIPING** IS INVOLVED

THE EDITOR'S PAGES

BUREAU DEFINES AIR CONDITIONING

"The minimum functions of 'air conditioning' are the control of temperature, humidity and movement of air within an enclosed space," according to a "service bulletin" prepared for members of the National Better Business Bureau, Inc., Chrysler Bldg., New York 17.

The bulletin goes on to say:

"Just what is air conditioning? The constantly expanding use of air conditioning in homes and in commercial and industrial establishments makes this an important definition.

"Authorities on the subject—architects, heating and ventilating engineers and manufacturers agree, and the Federal Trade Commission has ruled that—

"Air conditioning is the control, by a mechanical device, of the temperature, humidity and circulation of the air within a structure.

"The non-performance of any one of these three basic functions takes equipment out of the air conditioning class, according to numerous rulings of the Federal Trade Commission. (See FTC Stipulations 1467, 1772, 1883, 2450 and Docket 3974).

"Air conditioning equipment for summer comfort, cools, dehumidifies and circulates the air.

"Winter air conditioning equipment warms, humidifies and circulates the air.

"Year-round air conditioning equipment combines the functions of both summer and winter air conditioning equipment.

"Air conditioning equipment *may* do more than control the temperature, humidity and movement of air. It may, for example, filter the air to remove dust, bacteria and pollens. However, the three functions of controlling temperature, humidity and movement are the functions recognized by trade and government authorities as MINIMUM FUNCTIONS of air conditioning equipment.

"The bureau recommends that if equipment is advertised as providing 'air conditioning' or as being an 'air conditioner,' it offers, as a minimum, the control of the temperature, humidity and movement of air within an enclosed space.

"Air coolers, air purifiers, air humidifiers and dehumidifiers, and air circulators such as fans, should be described as such."

15 Years Ago

"These are stirring and changing times. Plants must be operated more efficiently than ever if they are to survive the increased wages and shorter hours of the NRA. Heating, piping, and air conditioning systems offer many opportunities for savings and increased efficiency." So read a note in the October 1933 issue of HPAC in connection with a plan advocating that part of the government's $3.3 billion appropriation for public works be devoted to modernization of mechanical equipment in existing public properties.

* * * * *

In the second of a series of articles on piping standardization, published in our October 1933 issue, Sabin Crocker explained the development and use of the standard for wrought iron and wrought steel pipe. A graph with his article gave a comparison of internal fluid pressure formulas for pipes and cylinders.

* * * * *

Realto E. Cherne described the air conditioning of the new Dime Savings Bank building, Brooklyn, in the October 1933 HPAC. Conditioned air is distributed by several systems, the main bank floor being handled by a low pressure and a high pressure system.

* * * * *

How unit heaters aid production by solving many plant problems other than straight space heating was discussed in another article in October 1933. Humidifying units, lumber drying, dispelling fog and steam, and other applications were cited.

A-B-C OF FIRE PREVENTION

Put out lighted matches and cigarettes before disposal.
Replace electric cords when worn or frayed.
Eliminate rubbish and unnecessary combustibles.
Vertical openings in buildings must be cut off to prevent spread of fire.
Educate school children in simple fire prevention.
Never smoke in bed.
Train everyone on what to do when fire breaks out.
Flameproof decorations in all public places.
Inspect frequently all places where fire may occur.
Replace wooden shingle roofs with fire-retardant roofings.
Examine and maintain all fire appliances.
Safeguard all heating equipment from surrounding combustibles.

Help Yourself **to Fire Prevention!**

OFFERS COURSE IN BUILDING MANAGEMENT

A course in building management is being offered for the first time this fall by the graduate school of Stevens Institute of Technology, Hoboken, N. J. It is believed to be the first on this subject ever offered in any school for graduate credit, and is open to engineering graduates and to other qualified persons on a noncredit basis.

Since building management represents a combination of many different aspects of training given at Stevens, this will be primarily a problem-solving course. It will be offered one evening a week for two semesters.

Covering topics of general application to the operation and maintenance of various types of structures, the course will include a study of heating, ventilating and air conditioning plants, elevators, plumbing and electrical systems. Students will also study building layouts for economical operation, accounting and operating cost analysis, and rental problems.

AGC CHARTERS PIPE LINE CHAPTER

The Associated General Contractors of America, Munsey Bldg., Washington 4, D. C., has announced that a charter has been granted to the Mid-Continent Pipe Line Chapter, which will have headquarters in Houston. The group is composed of contractors who specialize in the construction of cross-country pipe lines for the transmission of oil and gas.

THE EDITOR'S PAGES

UNIVERSITY OF MICHIGAN LIBRARIES

CONSTRUCTION UP 38 PERCENT

Building and construction contracts awarded in the 37 states east of the Rocky Mountains neared the billion dollar mark in July to set the cumulative investment commitment volume for this year through July at a point 38 percent higher than that reported for the first seven months of last year.

According to F. W. Dodge Corp., the total of contracts in July in the states east of the Rockies, as based on its field reports, amounted to $962,685,000. This total was 46 percent higher than that reported for July of last year and 3 percent higher than the total for June of this year.

The sharp gains were reflected in all major classifications of construction, with nonresidential volume up 56 percent over July of last year and 8 percent over June, residential up 45 percent over July of last year and down 2 percent from June, and heavy engineering works up 31 percent over July of last year and 1 percent over June.

ESTABLISHES NEW SALES HIGH

Carrier Corp. established a new high record of $55,734,519 in completed contracts and sales during the 12 months ended July 31, 1948. The comparable figure for the previous similar period was $46,120,771.

Net profit for the period was $2,531,456 after provision for income taxes, certain non-recurring expenses and reserves for contingencies. This compares with $2,378,744 for the 12 months ended July 31, 1947. These latter figures reflect carry-back tax credits for the three months ended October 31, 1946, and income tax provisions for the nine months following.

New orders during the 12 months ended July 31, 1948, totalled $50,209,802 and the corresponding figure for the preceding period was $40,445,390. As of July 31, 1948, the corporation had a backlog of unfilled orders amounting to $20,908,610 as compared with $26,433,327 a year earlier.

Commenting on these figures, Cloud Wampler, president, pointed out that the backlog had been reduced despite an increased volume of new business. He attributed the reduction largely to improved production operations, together with more normal ordering practices on the part of dealers and distributors. Referring to the first nine months of fiscal 1948, Mr. Wampler reported that completed contracts and sales were almost identical in amount with the volume of new orders booked after giving effect to all cancellations. He also stated that although foreign and marine orders were below those of the first nine months of fiscal 1947, domestic bookings were substantially greater and that total new business written in the present fiscal year was approximately 12 percent above that of the corresponding period a year earlier.

MATERIALS PRODUCTION EXCEEDS LAST YEAR

Overall production of building materials during the first half of 1948 exceeded the record-breaking rate set last year, and manufacturers' and dealers' inventories of many key materials showed substantial improvement, Melvin H. Baker, chairman of the Construction Industry Information Committee, recently stated.

"An analysis by the committee's economists indicates that, with the possible exception of certain steel items, the supply of materials and equipment will be adequate to meet all construction requirements during the remainder of this year," Mr. Baker said.

"However, that statement necessarily is based on the assumption that the available supply will not be reduced by transportation difficulties, expansion of the preparedness program, or serious work stoppages in basic industries, such as steel, coal, and transportation."

"Give—and give enough—through your Community Chest," says the Red Feather Kid.

WALTER C. WINKEL DIES

Walter C. Winkel, president of the Modine Mfg. Co., Racine, Wis., died on August 22 at the age of 59. Mr. Winkel had been a director of the firm for 25 years.

He joined the company as purchasing agent in 1920, and served successively as secretary, vice president and treasurer, executive vice president, and president in 1946.

INVENTORS' COUNCIL WANTS ANSWERS TO THESE

Conversion of light and heat energy into electric energy are among the items in the latest list of technical problems affecting national defense released by the National Inventors Council — which hopes that American inventors will submit solutions or suggest approaches that may lead to solutions of these problems.

Efficient methods of converting sunlight to electricity have not yet been developed, according to the council. Equipment thus far developed for converting heat energy into electricity has had defects that make it "quite uneconomical".

Other technical problems on the list include instruments for the measurement of humidity, testing stresses at high temperatures, and an automatically-controlled gasoline nozzle.

The council, a voluntary group of distinguished scientists and engineers, has compiled this and previous similar listings in cooperation with the armed services. A statement of each problem is given, together with approaches made to date, and their deficiencies or defects.

Technical Problems Affecting National Defense (National Inventors Council List 1948-1, 8 pages) may be secured without charge by writing to the council in care of the Department of Commerce, Washington 25, D. C.

Heating Piping & Air Conditioning

with which is merged the Aerologist

Design, Installation,
Operation, and Maintenance:
Industrial, Commercial, Institutional,
and Public Buildings

Board of Consulting and
Contributing Editors . . .

N. R. Bernz, Leo F. Collins, Sabin Crocker, R. C. Doremus, Philip Drinker, Walter L. Fleisher, F. E. Giesecke, William Goodman, William A. Hanley, J. J. Harman, R. S. Hawley, E. P. Heckel, R. E. Hieronymus, J. C. Hornung, John Howatt, Lee P. Hynes, C. W. Kimball, Dwight D. Kimball, A. C. Kirkwood, Charles S. Leopold, Samuel R. Lewis, H. C. Murphy, Alfred J. Offner, F. B. Rowley, Robert P. Schoenijahn, Kalman Steiner, T. S. Tenney, Rush D. Touton, Eph. A. Tyler, W. H. Wilson.

Editor.....C. M. Burnam, Jr.

Associate Editor.....Thomas V. Johnson

Advertising Staff . . .

Wallace J. Osborn
New York—Murray Hill 9-8293

Robert A. Jack
Cleveland—Yellowstone 1540

James D. Thomas
Chicago—State 2-6916

George C. Cutler
Chicago—State 2-6916

R. P. Wettstein
Los Angeles—Tucker 2779
Portland—Garfield 1903
San Francisco—Yukon 6-2522
Seattle—Alder 6365

Publisher.....Frank P. Keeney

Manager.....Charles E. Price

Production Manager....Lawrence A. Doyle

Published monthly by the Keeney Publishing Co., 6 North Michigan Avenue, Chicago 2, Illinois. Telephone: State 2-6916. Subscriptions: U.S. and possessions, $3.00 per year; Canada, Cuba, Mexico, Central America, South America, $4.00 per year; other, $6.00. Current copies, U.S. and possessions, 35c each; back copies, 60c each. January 1948 issue, $1.50 per copy. Member Audit Bureau of Circulations and Associated Business Papers, Inc.

Copyright 1948 by the Keeney Publishing Co.

October 1948 . . . . Vol. 20, No. 10

The Editor's Pages (news, notes, and comment)..... 67
Changing Compressed Air Piping Improves Operations at Martin, by Erle Elliott..... 73
Jurisdictional Decisions Announced..... 76
The NDHA Corrosion Tester—Why and How It's Used, by Leo F. Collins..... 77
How to Be a Good Supervisor..... 80
Zoning Air Conditioning for Future Partition Changes, by Donald T. DuBain..... 81
High Pressure Hot Water—Details of Design and Operation, by J. R. Kell..... 85
Radiant Heating Pipes in an Extra-Thick Slab Reported "O.K." 88
Hospital Suggests Unusual Ideas on Heating and Air Conditioning, by John D. Dillon and R. P. Goemann..... 89
Pipes Pulverized Coal for Standby Fuel..... 92
Industrial Air Conditioning—Equipment Arrangement With Truss Roofs, by F. F. Stevenson and Jack F. Salsburg..... 93
Dehumidifiers Protect Priceless Documents..... 97
Steam Drives for Refrigeration Improve the Plant Heat Balance, by Terry Mitchell..... 98
Central Air Conditioning Serves Stores at Large Housing Project.. 100
Venting Heater Rooms in Apartment Project..... 101
The Engineers and the Doctors Have Many Interests in Common, by V. L. Sherman..... 102
Sam Lewis' Page—Scotch Marine Boilers Have Many Uses on Land and Sea..... 104
Question of the Month..... 106
Room Air Temperatures for Ice Skating Rinks..... 106
Supplying Heat and Power to College Building Group..... 107
"Open for Discussion"..... 109
Equipment Developments..... 181
Executive Changes..... 194
New Books & Reports..... 197
Meetings & Conventions..... 200
Recent Trade Literature..... 206
Index to Advertisers..... 224

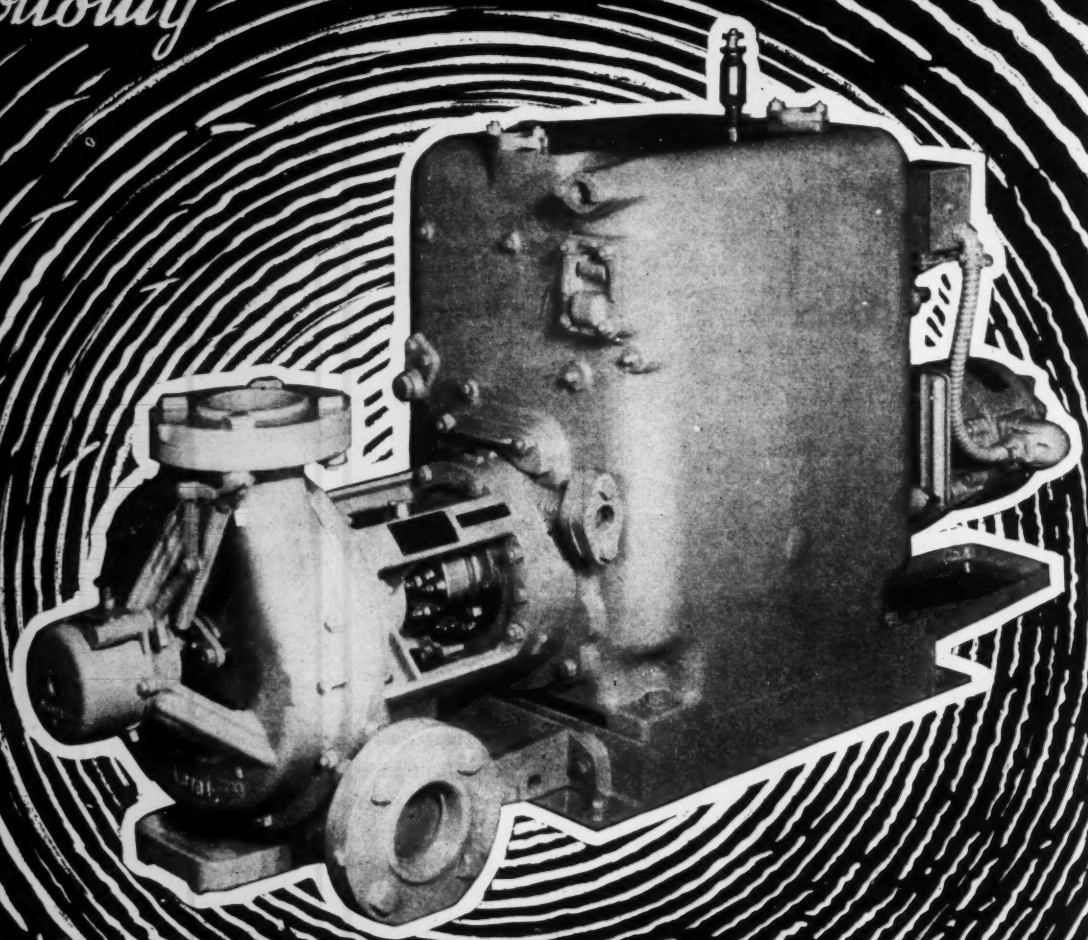
Heating, Piping & Air Conditioning is indexed regularly by Engineering Index, Inc.

Journal Section of the American Society of Heating and Ventilating Engineers

Are Automatic Shutters Justified on a Gas-Fired Conversion Burner?, by William M. Myler, Jr., and Harlan W. Nelson.... 111
Performance of Fourteen Masonry Chimneys Under Steady State Conditions, by Paul R. Achenbach and Selden D. Cole..... 119
Chicago Meeting and Exposition..... 129
1949 Nominations..... 130
Nominees for 1949 Officers..... 131
Nominees for Members of Council—Three Year Term..... 133
Summary of Local Chapter Meetings..... 136
Candidates for Membership..... 137
Officers, Council and Committees..... 139

UNIVERSITY OF MICHIGAN LIBRARIES

Centralized Heating Economy



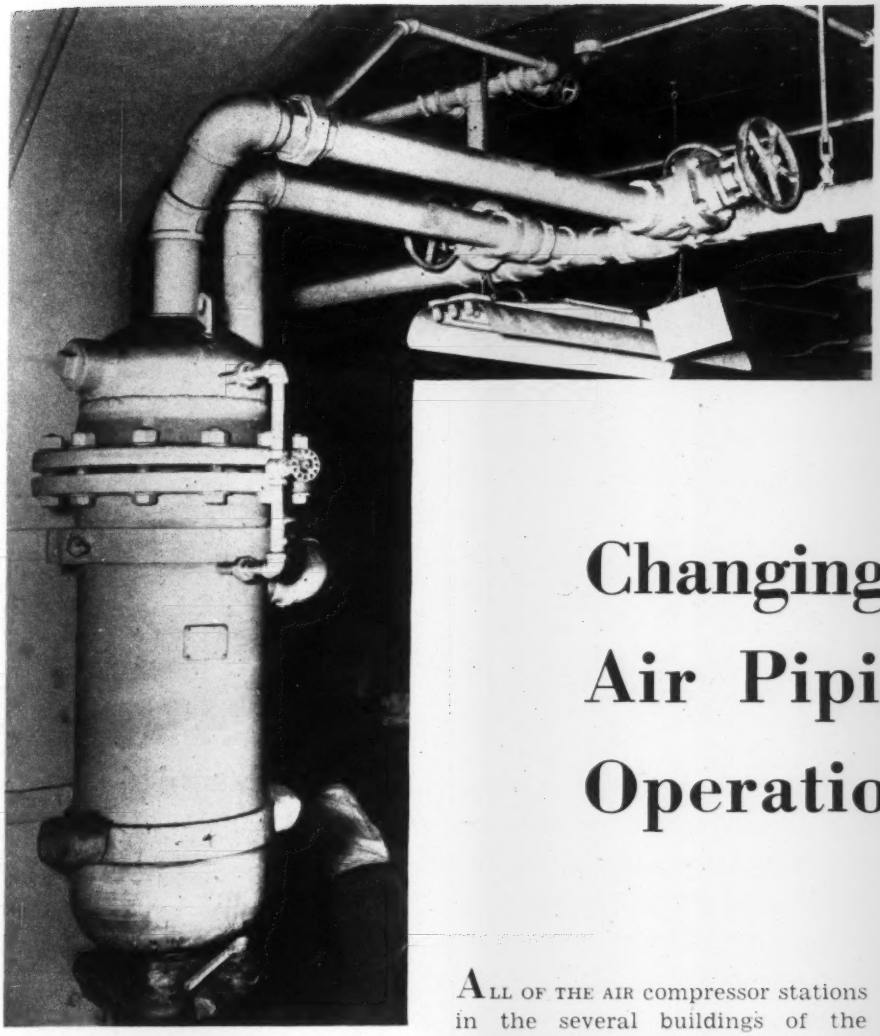
A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.



After this moisture separator in a 3 in. line was re-piped to permit flow in either direction, very gratifying results were obtained

Changing Compressed Air Piping Improves Operations at Martin

ERLE ELLIOTT, supervisor, utilities services, the Glenn L. Martin Co., Baltimore, explains the alterations in the compressed air piping whereby the air compressor stations in the various buildings are tied together so that any one of them can supply all the air required for week-ends, odd shifts, and other occasions when only a limited air quantity is needed. The ease with which compressed air can be adapted to numerous manufacturing processes has made it of prime importance at this aircraft plant

ALL OF THE AIR compressor stations in the several buildings of the Glenn L. Martin Co., Baltimore, are tied together so that any one of these stations can supply all the air required for week-ends, odd shifts, or any other occasion when only a limited quantity of air is needed.

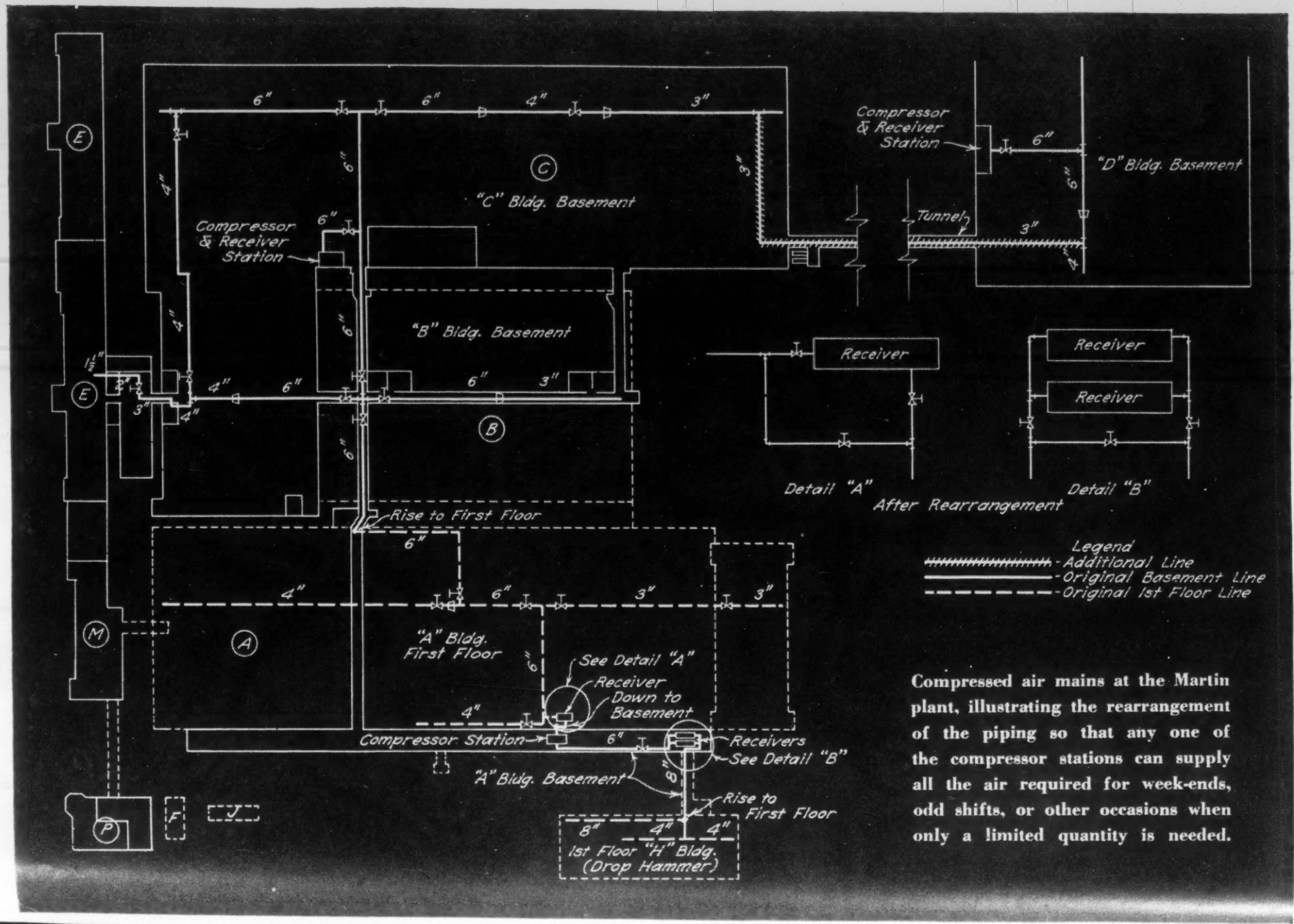
The ease with which compressed air can be adapted to numerous manufacturing problems has made it of prime importance at the Martin company. During the war, the rapid expansion of the plant and its facilities made necessary the consideration of many new problems and adaptations to rapidly changing manufacturing methods. The problems of adequate piping sizes and compressor capacity were recognized as basic, and adequate installations were provided, according to the outline of station locations and sizes of mains shown in the sketch.

The main plant capacities comprise the following: "A" building, station four, 400 cfm, two stage, five step loading, synchronous motor driven units, each with an aftercooler; "C" building, station three, 600 cfm, two stage, five step loading, synchronous motor driven units with one aftercooler and receiver. One receiver serves the "A" building, and two receivers serve the drop hammer building.

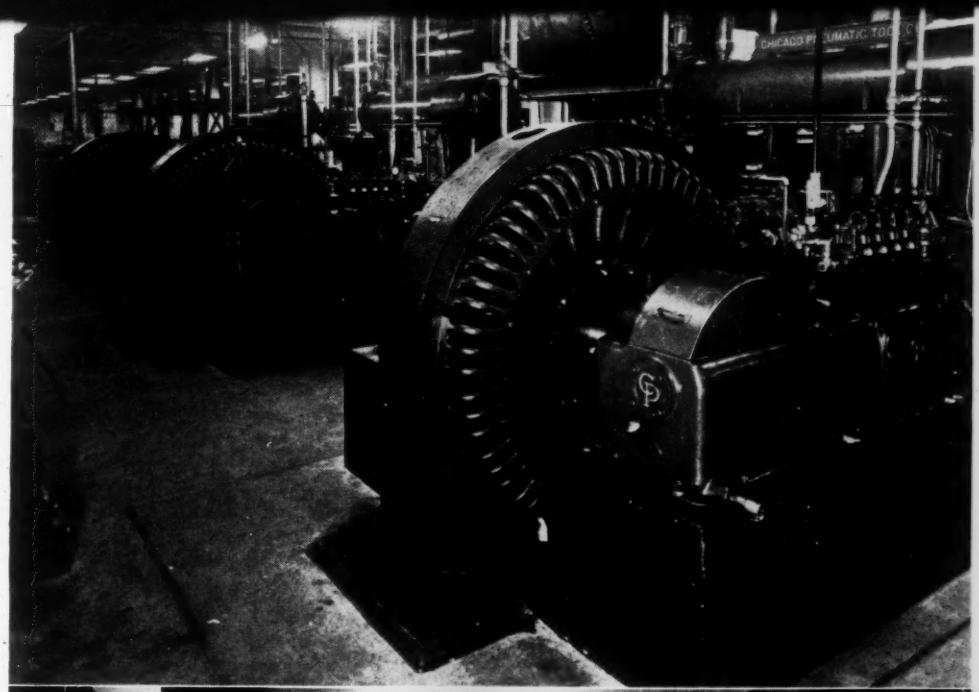
Additional installations of single stage, two step loading, induction motor driven units are located at the airport hangars. However, these units were not considered in any tie-in program because of their small capacities, which could be readily supported in case of an outage by portable units which are available at the hangars.

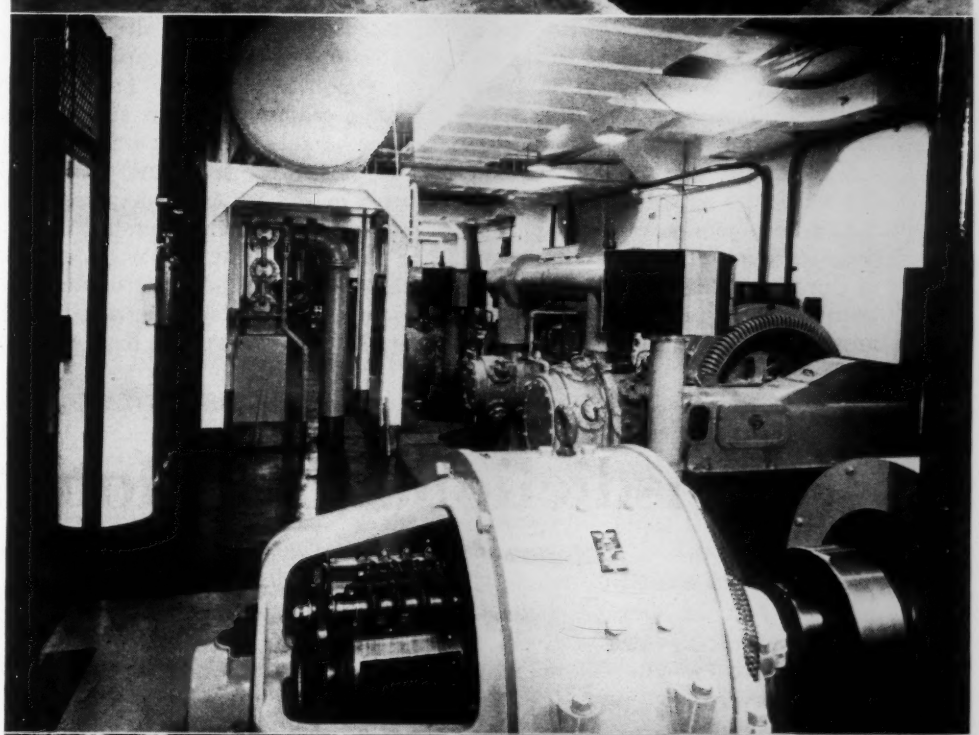
The piping layout, as installed, tied the "A" building and "C" building stations together with a 6 in. diameter line. However, this installation would allow only the "C" building station to be taken out of service, because the piping arrangement at the receiver in the "A" building and the drop hammer building acted as part of the mains (original as shown in the accompanying sketch). This arrangement prevented supplying air to parts of "A" building and the drop hammer building whenever these receivers

UNIVERSITY OF MICHIGAN LIBRARIES



Compressed air mains at the Martin plant, illustrating the rearrangement of the piping so that any one of the compressor stations can supply all the air required for week-ends, odd shifts, or other occasions when only a limited quantity is needed.





Top—The air compressor installation in the "C" building. Center—The general air compressor installation in the "D" building. Bottom—This is the air compressor installation in the "A" building

were out of service. "D" building, as will be noted in the sketch, was independent of all other buildings.

The primary considerations in laying out the original station locations were that they should be centrally located for the areas to be served and isolated from each other, for greater security if the plant were ever bombed or partially disabled for any reason.

Compressed Air Loads Analyzed

At the first approach to the problem of measuring compressed air output, it appeared that it would be very costly if air flow meter installations were required. After further consideration, however, it was decided to measure the input current to the motor and exciter and see whether the actual load position could not be read from a recording wattmeter.

A test installation was made at a cost of approximately $25. This clearly recorded the current input, position, and time the unit operated at no load, one-quarter, one-half, three-quarters, and full load. With this information it was easy to determine the actual quantity of compressed air with a fair degree of accuracy. Manufacturers' ratings of compressor output at different loadings were used as the bases of calculations.

Further analysis of the recorded charts made possible rescheduling compressor operation and additional checks proved valuable in determining compressor efficiency. Overhauling a compressor which showed low current input brought it up to loadings comparable to other compressors. Readings were taken over a period of approximately two weeks during the summer months when the greatest loads are expressed.

The wattmeter revealed that the stations were loaded as follows under peak loads, figures being given to the nearest 100 cfm: "A" building, 1200 cfm; "C" building, 1000 cfm; "D" building, 800 cfm; total, 3000 cfm.

At first it seemed best to take

advantage of the 1600 cfm reserve in the "D" building and install a 6 in. tie line between the "C" and "D" buildings. The distance from the 6 in. main in the "C" building to the 6 in. main in the "D" building is approximately 1200 ft. However, further consideration indicated adequate flexibility for any expansion without the "D" building's total reserve. Therefore, only enough capacity to supply the "D" building was necessary. This resulted in a 3 in. tie between the "C" and "D" buildings, which cost approximately 60 percent less per lineal foot and required only a distance of 700 ft.

Moisture Separator Re-piped

After completion of this tie line, a test run failed to come up to expectations and it seemed as if an error had been made, or that the 3 in. line from the "D" building was too small. Subsequent checks to find out where the mistake was disclosed that a large moisture separator had been installed across the 3 in. main in the "C" building, without having been properly recorded. After this unit was re-piped to permit flow in either direction, very gratifying results were obtained. The "D" building compressor maintained moderate loads with a pressure drop of less than 10 lb.

To complete the installation program, bypass valves were installed on the "A" building receivers as indicated in the sketch, details "A" and "B."

This arrangement makes it possible to remove any receiver or station from service for repair, inspection, and overhaul without interrupting plant air facilities. It has resulted in greater flexibility, increased maintenance efficiency, has decreased operating manpower requirements by 60 percent and has effected current savings of 30 percent over previous years.

Further refinements are the installation of temperature control for compressor jackets and intercoolers which maintain the outlet water at constant temperatures.

A series of recording pressure gages in the boiler room gives immediate notice of any unusual load or failure of loading devices. This warning gives the operator an opportunity to contact a roving operator by auto-call system in adequate time to switch compressors or add an additional unit as required to maintain an air pressure between 100 and 105 lb. Recorded pressures at points of use show that pressures available for equipment are never less than 95 lb.

Branch main distribution lines to service outlets (not shown on the sketch) are sized between $1\frac{1}{2}$ to 2 in. diameter. Load factor is 30 percent. There are normally from 36 to 48 one-half inch service outlets on each service main. Load requirements for tools and air equipment are taken from manufacturers' ratings for the tools to be used.

Moisture Traps to Eliminate Wear

All branch distribution lines are taken off the mains through a moisture separator. Additional traps and separators are used at compressors, intercoolers, aftercoolers, and low points of the distribution system. However, entrained moisture occasionally carries through in the hot humid summer season, and it is necessary to install moisture traps at the entrance to a few of the air tools to eliminate excessive wear and maintenance.

Jurisdictional Decisions Announced

In the first decisions reached under the voluntary machinery created last May for the settlement of jurisdictional disputes in the construction industry on a national basis, two controversies have been disposed of, according to the bulletin Construction, which is issued by the Building Construction Employers Association of Chicago. Each of the two decisions, both unanimous, involved two cases, one brought to the joint board by management and one initiated by a union.

The decision in a case between the United Association of Journeymen Plumbers and Pipefitters and the Sheet Metal Workers International Association, and involving a dispute in the installation of copper piping in breweries for beer lines, wort lines, yeast lines, and refrigeration in connection with attemperator tanks, is as follows:

"The installation of streamlined or other manufactured copper pipe or fittings for beer lines, wort lines, yeast lines is the work of the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada. The installation of copper attemperator coils in the interior of tanks and vats in breweries is the work of coppersmiths, members of the Sheet Metal Workers International Association."

In a case between the Sheet Metal Workers International Association and the International Association of Bridge, Structural and Ornamental Iron Workers, and involving the whole issue of the installation of steel decking, the decision is as follows:

"The installation of steel decking for roofing, if 10 ga or lighter, is the work of the Sheet Metal Workers International Association. The installation of steel decking for flooring is the work of the International Association of Bridge, Structural and Ornamental Iron Workers. This decision cannot alter previous decisions of record, such as, January 26 1928 (Holorib), May 19, 1947 (Q-Panel), June 3, 1948 (Metro-Deck). Whenever steel decking for flooring or roofing is used as a raceway for electrical wiring the electrical work in connection with the raceway is that of the International Brotherhood of Electrical Workers."

A third decision, in a dispute between the plumbers and electricians over preheating and stress relieving of welds on high pressure pipe, is expected soon. Hearings in a dispute between the carpenters and laborers and involving jurisdiction over the stripping of concrete forms will be held at an early date.

UNIVERSITY OF MICHIGAN LIBRARIES

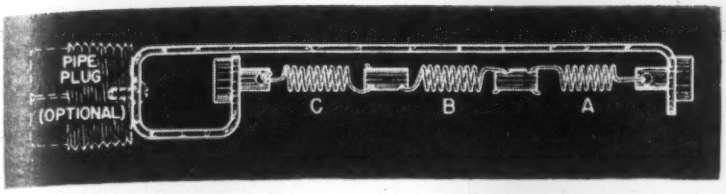


Fig. 1—The NDHA corrosion tester, comprising three helical coil specimens electrically insulated from each other and the supporting frame. Normally, the pipe plug is used only when the tester is to be installed in a pipe line

THE NDHA CORROSION TESTER

Why and How It's Used

LEO F. COLLINS, member of HPAC's board of consulting and contributing editors and well-known authority on corrosion problems, explains the need for studying corrosion rates and the development, features, performance, and uses of the NDHA corrosion tester, which—when applied correctly—seems to have demonstrated its reliability as a measuring device. His article is of real practical value to engineers and others who must design, select, operate, and maintain equipment for piping, heating, and air conditioning applications

Corrosion might be called one of the "scourges of industry." Despite the vast amount of technical information available, such troubles occur largely because theory fails to make clear the manner in which various corrosion controlling factors influence one another. Thus it is that engineers have long needed an inexpensive, rapid, and reasonably accurate device capable of measuring the cumulative effects of all the factors involved; that is, a "corrosion meter."

Development of the Tester

In the fields where it has been applied correctly, the NDHA corrosion tester seems to have demonstrated its reliability as such a measuring device. To those who have had access to most of the data, it appears, too, that equally as satisfactory results can be obtained in other fields if the device be applied properly. In an effort to supply criteria that will assure such application, this article has been prepared.

In 1930 a subcommittee of the research committee of the National District Heating Association was created to determine the causes for, and the prevention of, corrosion in the steam heating systems of large buildings. In an effort to learn whether or not corrosion really constituted a problem in such buildings, a questionnaire was distributed. The meager information so obtained made it clear that if progress was to be made, a means would have to be devised whereby direct corrosion measurements could be made under actual operating conditions.

After several failures, a design substantially as shown in Fig. 1 came into being. Thereafter, measurements were made in some 50 buildings located in nine of the principal cities of the U.S.A. These findings were so informative that they stimulated the use of the device in other fields.

While most of the data obtained in these various studies have been published [see items 1, 2, 3, 4, and 5 in the list of references], a large number of inquiries have recently been received seeking information as to demonstrated fields of use, design features, installation criteria, performance characteristics, significance of measured values, and availability. This article attempts to supply all the information available covering each of these considerations.

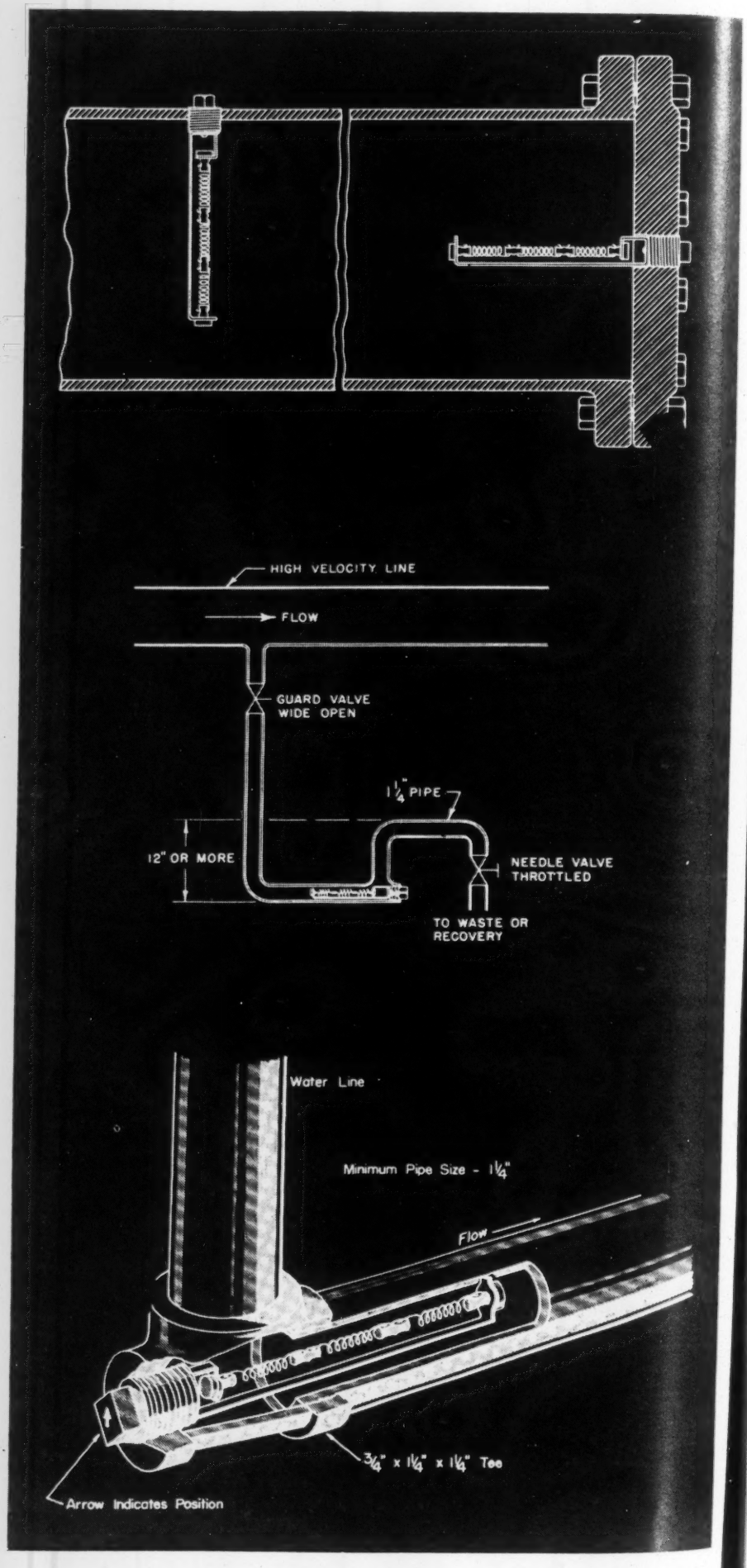
Where Tester Has Been Used

Testers have been used in the following types of studies and the data are available:

1) To reveal the role of dissolved carbon dioxide in steam condensate corrosion.

Copyright, 1948, by Leo F. Collins.

Fig. 2 (top)—The correct method for installing the tester in a pipe 8 in. or larger. Fig. 3 (center)—A bypass arrangement for installing the tester in high velocity lines. Fig. 4 (bottom)—How to install the corrosion tester in small diameter piping



2) To measure the effectiveness of inhibitors (chemicals) added to steam to minimize corrosion.

3) To compare the resistance to corrosion of a number of metals when exposed to corrosive condensates.

4) To compare the resistance to corrosion of metals proposed for domestic hot water services.

5) To compare the resistance to corrosion of selected alloys exposed to boiling dilute sulphuric acid solutions.

6) In "atmospheric" tests in an underground steam distribution system.

7) To compare the resistance to corrosion of metals when exposed to brine (NaCl) solutions.

8) To measure corrosion at key points in boiler feedwater processing systems.

In addition to the above, testers have also been used in the fields of food processing, gasoline refining, acid pickling of metals, municipal water supplies, and sewage and sanitation, but the results have not been released for publication.

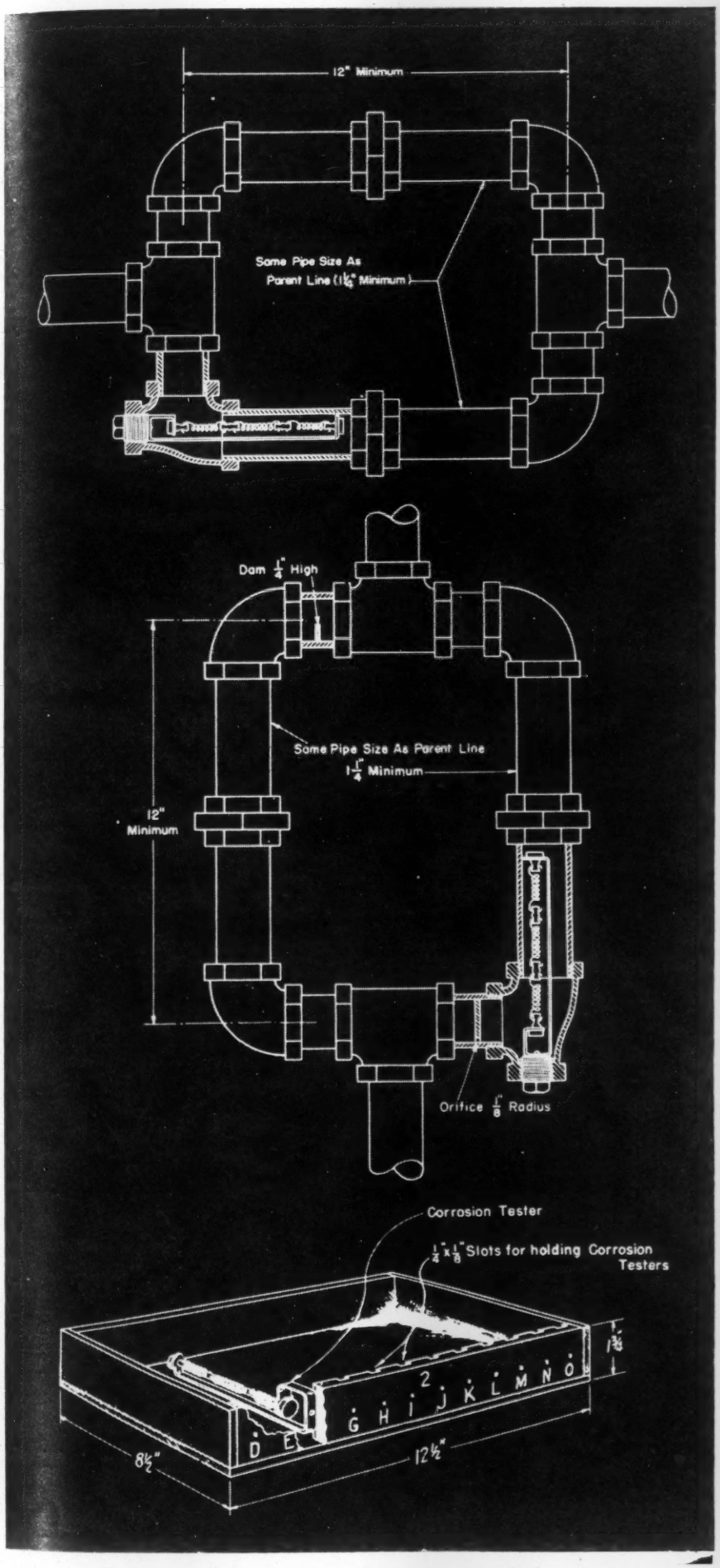
Design Features of Corrosion Tester

From Fig. 1 it is clear that a tester is comprised of a train of three helical wire coils supported by a frame; that the coils are electrically insulated from one another and from the frame. Normally, a pipe plug as shown in Fig. 1 is used only when a tester is to be installed in a pipe line, and it is not an essential part of the unit.

The wire coils are the quantitative specimens, i.e., the specimens whose losses in weight during a known period of time reflect the rate of corrosion. The retaining frame (if of the same metallic composition as the helical coils) also serves as a qualitative specimen —that is, its appearance discloses whether pitting or more generalized corrosion is the "type" of attack to be controlled.

Experience attests that significant results can be obtained in 30

UNIVERSITY OF MICHIGAN LIBRARIES



days or less. If no measurable losses in weight (of the helical coils) occur in 30 days, the indication is that corrosion, *at the point in the system where the unit was located,* is of no practical consequence. If corrosive conditions are "severe", significant losses in weight occur in as little as one day.

Such rapid measurements are made possible by virtue of the facts that the helical wire coils present a maximum of area for a minimum weight, and their mass permits of very delicate weighing. Actually, about 1.5 sq in. of area is exposed in each helical coil. While the weight of a coil is dependent upon the density of the metal, for most metals the coils vary within the range 2 to 3 grams. Such a small mass can be accurately weighed upon a delicate balance, and because of the latter, extremely small losses in weight can be measured.

Normally, three helical coils of the same material are used so that "check" results are obtained. If materials of different compositions are used, the electrical insulators preclude the possibilities of the accelerating effects of galvanic action and stray current electrolysis. Any material that can be fabricated in the form of wire may be utilized. Materials (such as cast iron) that cannot be obtained in wire form have been employed as "strip" specimens. Experience attests, however, that such "strip" specimens should be used only as a last resort.

How to Use the Tester

It is impossible to describe in detail the installation techniques that will meet all possibilities. General criteria and the installation techniques that have been used in practice are all that can be presented.

General Considerations

A tester should always be situated so that the helical coils are subject to conditions comparable to those experienced by the surfaces of the confining vessel. If the confining

Fig. 5 (top)—This is the way the tester is installed in a partially filled horizontal pipe. Fig. 6 (center)—Method of installing the corrosion tester in vertical piping for intermittent operation. Fig. 7 (bottom)—In atmospheric tests, non-metallic exposure trays for the corrosion tester have been used

surfaces for which the corrosion rate is sought are cyclically wetted and dried, the device should be situated so that all three coils experience the same cycles. The rate of flow of the corroding medium over the unit should be substantially equal to the maximum rate within the confining vessel.

Demonstrated Techniques

In water systems and in atmospheric tests, the following installation techniques have been found satisfactory:

Large Diameter, Low Velocity Water Lines—In Fig. 2 it is shown that in low velocity lines of 8 in. diameter or larger, a unit may be installed either diametrically or longitudinally. Usually, it is desirable to locate the unit at the centerline of the pipe. It should be noted, however, that inaccuracies may ensue if the line is only partly filled even for short periods. In the latter case, installation below the liquid level is usually mandatory.

High Velocity Water Lines—When flow rates exceed about 5 fps, there is always the chance that a diametrically installed tester may be swept away and become lodged at a vital point. To guard against this, a bypass arrangement such as is sketched in Fig. 3 has been used. The throttle valve is set so that insofar as is possible, the same physical conditions prevail in the bypass line as in the main conductor.

Small Diameter Water Lines

The following three conditions have been encountered: Lines that are perpetually filled, horizontal lines that are partly filled, and vertical lines that operate cyclically.

Completely Filled Lines—Fig. 4 shows the preferable method. It is important to note that all three coils are in the flow stream. A pipe plug that precludes the use of bushings is essential, since the latter may pull one or more coils back of the flow stream.

Horizontal Lines Partly Filled—Fig. 5 shows the preferred method of installation in horizontal lines that are not perpetually filled. The use of the pipe loop permits gases, which may accompany a liquid medium, to pass freely while keeping the tester always submerged in a manner comparable to the wet-test portion of the line.

Vertical Lines Intermittently Operated—Fig. 6 shows the preferred method of installation in vertical lines wherein a liquid medium flows cyclically and the lines are drained during no-flow periods.

Exposure Trays

In atmospheric tests, non-metallic trays have been used. A sketch of such a tray is shown in Fig. 7.

The object of the tray is to keep the tester submerged when liquids are involved, and to collect debris over the metal surface if such debris is a controlling factor. If protracted periods of drought occur the liquid will evaporate, or it may be drained out slowly through an orifice in the bottom of the tray.

[A second article by Mr. Collins on this subject will present data attesting the performance of the corrosion tester.]

List of References

1) Heating, Piping & Air Conditioning: Corrosion in Steam Heating Systems, by Leo F. Collins with Everette L. Henderson, September 1939-May 1940, inclusive.

2) Proceedings, American Society for Testing Materials, Vol. 40, 1940 by J. H. Walker.

3) Power Plant Engineering, Vol. 48, 1944, by Leo F. Collins.

4) Proceedings, Water Conference, Engineers Society of Western Pennsylvania, 1943, by Leo F. Collins.

5) Proceedings, National District Heating Association, 1948.

How to Be a Good Supervisor

What kind of a supervisor does an employee want? The question was pretty well answered recently in a talk by Fred Smith, executive vice president of the Foremen's League, at a meeting of the National Warm Air Heating and Air Conditioning Association. Here are eight points (given in somewhat abbreviated form) from Mr. Smith's talk:

1) He wants one who is courteous, one who gives a friendly answer to a civil question. In short, one that's got good manners.

2) Another thing he wants is the give-and-take that we all look for in any regular fellow. You know what I mean. One who can admit when he is wrong . . . one who can let the little things pass and not needle you about them six months later.

3) The employee is looking for a supervisor who is easy to talk to. Recently, I met two men who were outstandingly popular among employees. They do not have any more brains and no more technical skill. However, they could work employees like putty. I set out on a one man investigation to find out what these men had that other supervisors didn't have. Here it is: each of these men always looked an employee straight in the eye with an interested expression on his face while he listened.

4) An employee is looking for a supervisor who knows more than he knows. This doesn't mean only in technical knowledge but also in other things. The first part of being a supervisor is being "super."

5) Again, the employee wants his supervisor to compare well with the other supervisors in the plant.

6) In thinking about the things the employees are looking for in order to be proud of their supervisor we come to one quality which many employees will mention . . . "sticks up for his men." I believe a supervisor can be a little bit tougher on his men than other supervisors just so long as he sticks up for his men.

7) He wants a supervisor who can get results. Not one that procrastinates or is always going to think about something but one that can get in there and get the job done.

8) An employee wants to feel that his supervisor is interested in him as an individual.

UNIVERSITY OF MICHIGAN LIBRARIES

ZONING AIR CONDITIONING

for Future Partition Changes

DONALD T. DuBAIN, project engineer, Western Air & Refrigeration, Inc., describes the air conditioning features of the new 10 story Los Angeles Mirror Building, which requires 1200 tons of refrigeration. He gives particular attention to the zoning and the control—of particular interest because the top five floors are to be designed to suit the requirements of prospective lessees, and the interior architectural plans could not be made during the initial phase

THE NEW Mirror building in Los Angeles represents a definite step in the advancement of air conditioning in large building structures. The building was designed specifically as a newspaper plant for the city's new afternoon daily, the Mirror, published by the Times-Mirror Co., parent organization of the Los Angeles Times.

Situated at opposite ends of a city block, the 12 year old Times building and the new Mirror building are joined by a three-story-and-basement wing containing the mechanical production departments which are used by both papers. Thus the two buildings are continuous throughout their basement paper storage areas, pressroom, second floor mailing rooms, and third floor composing room.

The Mirror building rises 10 full stories above street level with three basement levels below. At the present time only that part of the structure from the fifth floor down is being used by the Mirror, with the expectation that the remainder will be needed within a matter of a few years. Hence, the upper five floors are being leased on a short-time basis.

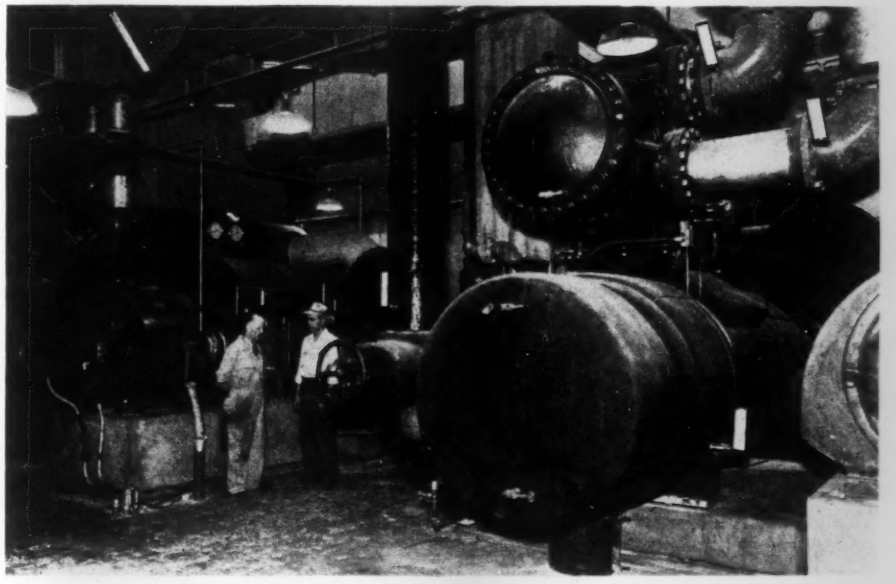
Since the interiors of the upper five floors originally had to be designed to suit the requirements of the prospective lessees, complete interior architectural plans could not be drawn for these rental floors during the initial phase of design. This necessitated that the mechanical engineer make advance predictions of the heating and cooling requirements of these floors, and to arrange for a type of zoning which would conserve valuable floor space and reduce to a minimum the air distribution duct layout and time of installation when the partition walls and ceiling heights have been decided upon.

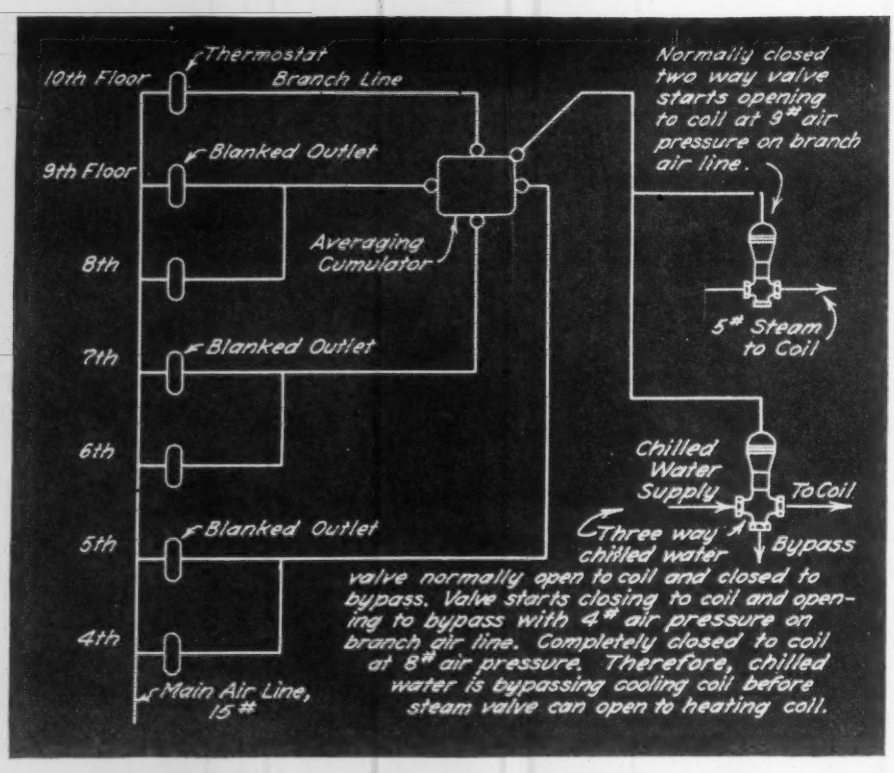
To accomplish this, floors Nos. 4 through 10 were cut vertically into six zones with the air conditioning apparatus serving these zones located in the penthouse equipment room above the 10th floor and the elevator machinery room floor above the penthouse equipment room.

Each zone thus required only the running of six duct shafts extending vertically downward, with each shaft containing the main supply and return duct risers for each zone. By taking off the riser ducts at the highest elevation above each floor, it will be necessary only to connect to these take-offs and run to the required locations and drop ceiling outlets.

Conditioned air is supplied to each of these zones by one large backward curved blade centrifugal fan which pulls air through a conventional type plenum which houses the air filters, cooling coils, heating coils, and pan type humidifier (in that order in the direction of air flow). Located close to and operating in conjunction with each supply unit is an exhaust fan which provides positive removal of air from each zone. The exhaust fan discharge duct splits, with one branch extending to the atmosphere

Compressor room in the sub-basement, showing a portion of the two 600 ton centrifugal refrigeration machines




10th Floor
Thermostat
Branch Line
9th Floor
Blanked Outlet
8th
Averaging Cumulator
7th
Blanked Outlet
6th
5th
Blanked Outlet
4th
Main Air Line, 15#
Normally closed two way valve starts opening to coil at 9# air pressure on branch air line.
5# Steam to Coil
Chilled Water Supply
To Coil
Three way chilled water
Bypass
valve normally open to coil and closed to bypass. Valve starts closing to coil and opening to bypass with 4# air pressure on branch air line. Completely closed to coil at 8# air pressure. Therefore, chilled water is bypassing cooling coil before steam valve can open to heating coil.

Readings of the four thermostats in each zone are averaged by an averaging cumulator which actuates a three way bypass valve at the chilled water coil or a steam valve at the heating coil. This is a partial schematic sketch only, and does not show the branch switches, solenoid interlock on fan circuit, three way air valves, or limit heating stat

through a goose neck fitting on the roof and the other branch connected to the supply plenum between the outside air intake louvers and the filter section. By the installation of automatic dampers in each of these branches, together with a damper back of the outside air intake louver, the proportions of the recirculated air and outside air mixture fall under the control of two outside air thermostats located in the outside air intake of each supply plenum. This feature is important from an economic standpoint—both first cost and operating cost—since during the peak seasons the dampers operate to decrease the load on the air conditioning apparatus and at the same time provide a minimum amount of outside air for ventilation purposes.

With the outside air damper minimum position being such that the minimum outside air supply is never less than 25 percent of the total air supply, even at extreme conditions, and the exhaust fan cfm picked for approximately 75 percent of the supply fan cfm so that when the exhaust damper is closed and return damper open, only 75 percent will be return air and the other 25 percent will thereby be pulled from the outside, the damper control can be clearly explained by the schedule shown in Table 1.

Temperature Control System Simplified

Because it was felt that floor usage would be fundamentally the same for each zone (office space) as well as exterior exposure, and would not involve extreme load fluctuations between floors in each zone, the interior temperature control system for these floors was therefore economically simplified.

For each zone, four thermostats are located on the fourth, sixth, eighth and 10th floors with blanked thermostat outlets on the fifth, seventh, and ninth floors which can be used as alternate control for the floors below them. The readings of the four are averaged through an averaging cumulator which in turn actuates a three way bypass valve at the chilled water coil or a steam valve at the steam coil, depending upon whether the average temperature calls for heating or cooling. This is illustrated in an accompanying sketch.

With the upper seven floors supplied, exhausted, and controlled as described above, the air conditioning of the lower three floors—though fundamentally the same in regard to filtering, return, and outside air control—differs widely in zone temperature control because of varied load conditions ranging from the large entrance and lobby space on the first floor, the mailing and electrical control rooms on the second floor, and numerous offices, etc., on the third floor.

Served from a fan room at the north end of the third floor, the zone temperature control employs a hot and cold plenum system which differs somewhat from the conventional type.

This system incorporates the two plenums, one above the other, with insulated separation, but instead of heating coil below cooling coil (as in the conventional type) a separate steam coil is installed in each zone duct connection at the lower plenum. In the place of the conventional heating coil, a manual bypass damper is installed so as to give greater flexibility to the system during the different seasons and to eliminate unnecessary static pressure loss.

Thirteen zones (six on the third floor, three on the second floor, and four on the first floor) each have their room temperatures controlled by a thermostat operating a pair of opposed mixing dampers and steam coil. One branch duct containing a damper and taking off the cold plenum, and one branch duct containing a damper and steam coil and taking off the lower plenum, join in one trunk duct supply to each zone. The dampers are linked together so that on falling room temperature, the zone room thermostat modulates the cold plenum damper closed and simultaneously modulates the opposed damper in the heating duct and steam valve at the zone heating coil open. Under certain conditions of mild outside air temperature when it will be unnecessary to open the steam valve when the lower plenum mixing damper opens, a limiting ductstat is installed to prevent opening of the steam valve above 78 F. Differing from the upper floor supply system in which single width fans are employed to "pull" air through the air conditioning plenum, this

UNIVERSITY OF MICHIGAN LIBRARIES

system employs a double width fan with motor and fan boxed in directly behind the filter bank and pan humidifier and discharging into the plenums discussed above—thus creating high positive pressure for movement of air. The cold plenum is maintained at a constant predetermined temperature by means of a ductstat which functions to operate a three way valve either to supply or bypass the chilled water coil.

Pressroom Utilizes 100 Percent Outside Air

The pressroom, which is supplied from a fan room in the sub-basement, utilizes 100 percent outside air under all conditions because of the undesirable elements contained in the room air which make it impractical from a maintenance standpoint to return any of this air to the intake plenum. Conditioned air is supplied by two large centrifugal fans pulling through plenum housings similar to those in the penthouse equipment room.

Positive removal of air is obtained by a large axial flow fan on the roof adjacent to the equipment penthouse and north of the cooling tower. The air passes through a set of parallel ink filters before being discharged to the atmosphere.

On all of the above systems, constant room humidity is controlled by means of a humidistat located to feel room air which functions to open an automatic steam valve on a steam coil immersed in a water pan on a fall below the humidistat setting. Also employed on all these systems, because of the definite need for efficient filtering in this section of the city, are electrostatic air cleaners selected to remove 90 percent of all undesirable dust and smoke particles.

Table 1—Damper schedule for the various outside air temperatures

Outside Air Temperature	Outside Air Damper Position	Return Air Damper Position	Exhaust Air Damper Position
50 F & below	25% min. pos.	Open	Closed
Rises 50 F-60 F	Modulates open	Modulates closed	Modulates open
60 F	Wide open	Closed	Wide open
60 F-80 F	Wide open	Closed	Wide open
Rises 80 F-90 F	Modulates closed	Modulates open	Modulates closed
90 F & above	25% min. pos.	Open	Closed

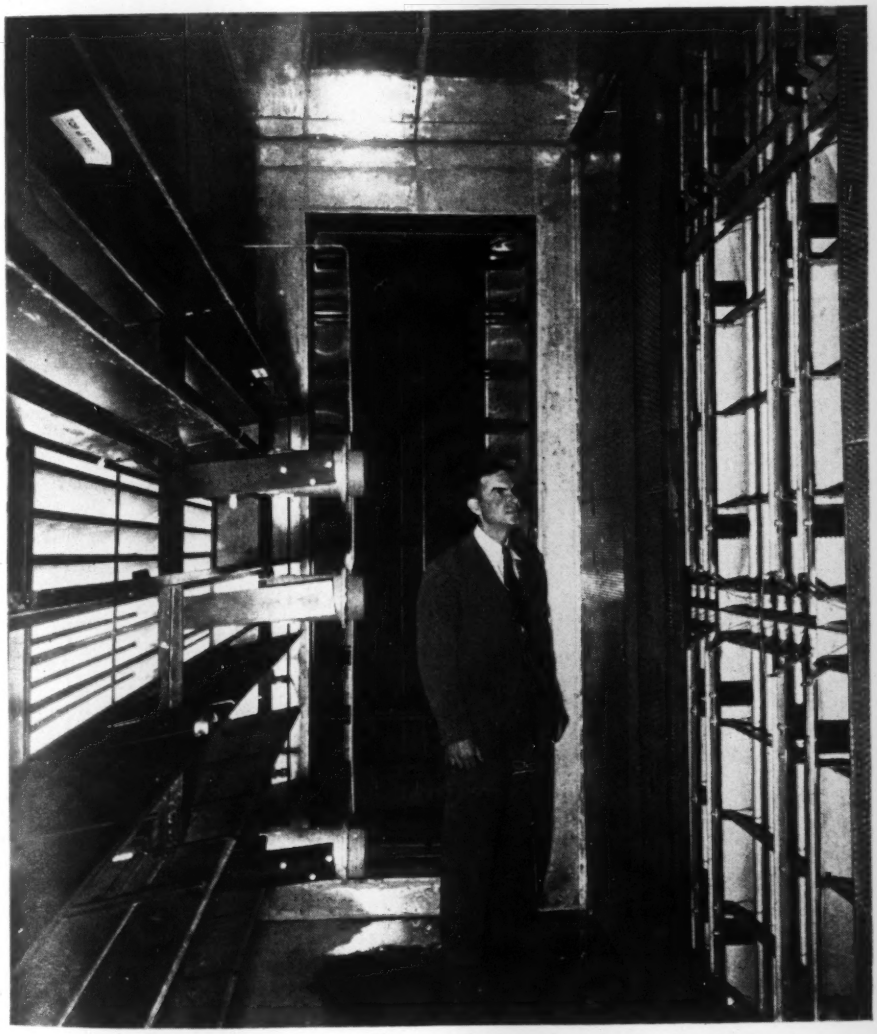
Together with the above described air handling apparatus are miscellaneous exhaust and supply units for the storage and sub-basement levels, toilet room exhaust, and elevator shaft exhaust. The supply air for the freight and passenger elevator shafts is taken off the discharge duct of two of the exhaust fans in the equipment penthouse which pull conditioned air from the interior rooms.

To summarize, the air handling equipment consists of 32 separate fans, ranging in capacity from 2500 to 51,000 cfm and driven by motors ranging in size from ½ to 20 hp. The total connected fan horsepower load is approximately 265 and results in a total circulation of approximately 628,200 cfm.

Because of the nearly uniform ceiling heights throughout the lower five floors, ceiling diffusers incorporating the supply and exhaust opening in one unit are used extensively. This installation feature constitutes the extensive use of the two duct system which employs the exhaust branch directly over the supply branch with the exhaust collar extending through the supply duct and connecting to the outlet.

Concentration of air conditioning apparatus, as described above, into five major fan rooms simplifies maintenance. This is an important feature, since the present building staff of the existing Times building will be responsible for the equipment in the new building.

Inside the plenum housing, showing outside air damper, return air damper, and intake side of the electrostatic air cleaner unit. This unit is in the penthouse equipment room



1200 Tons of Refrigeration

Load calculations showed that approximately 1200 tons of refrigeration would be necessary to meet the air conditioning requirements. However, in this load were included

four units in the equipment room on the third floor of the Times building in which the present air washers and eliminators are to be removed and a new system employing surface dehumidification and cooling is to be installed. This required extension of the new chilled water supply and return circuits into the Times building for future hook-up to the new chilled water coils.

Two 600 ton centrifugal machines were therefore installed in the subbasement refrigeration room. They have automatic prerotation vane control which operates to throttle compressor suction at reduced refrigeration loads. These vanes, controlled by a thermostat in the chilled water supply line out of the water cooler, are designed to meet load variations of 120 tons at minimum conditions to 1200 tons at maximum peak levels, thereby greatly increasing the economy of operation at the lighter loads.

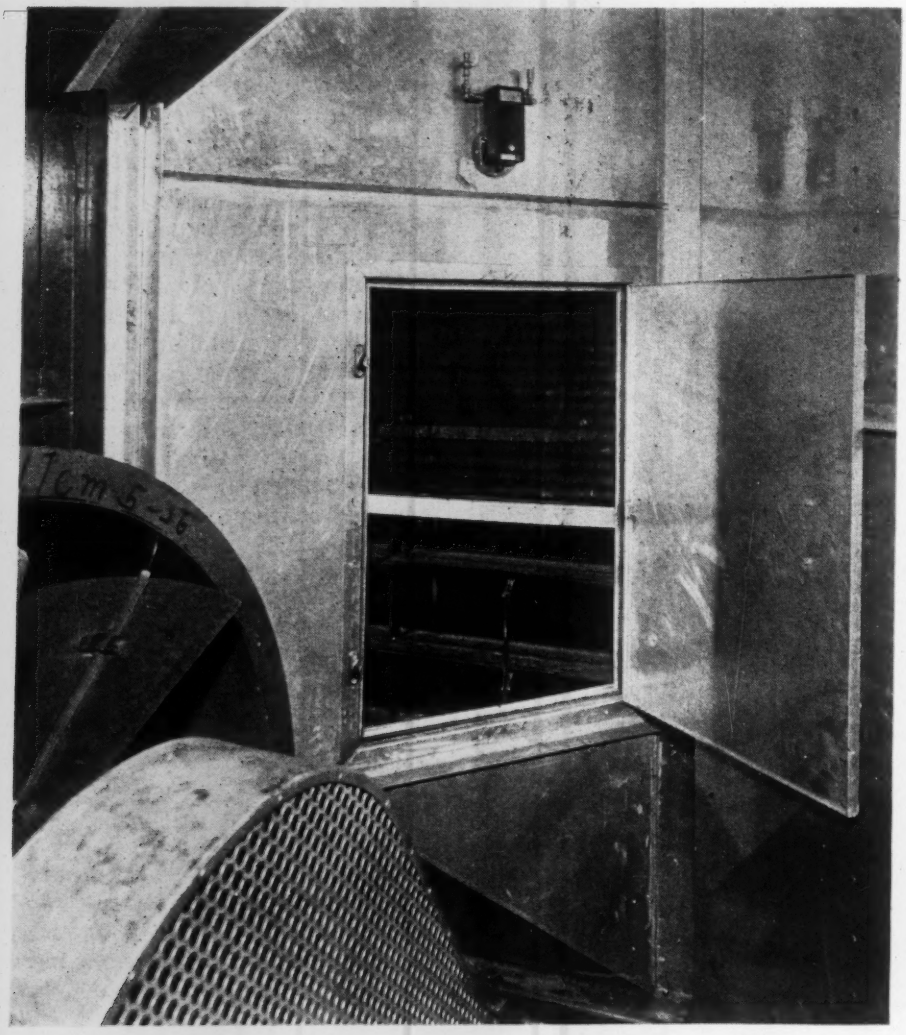
These compressors are driven through speed increaser gears by two 600 hp synchronous motors which start as induction motors and pull in sychronism as soon as the d-c field and a-c controller are in the proper phase relation. Interlock controls insure that the prerotation vanes are closed before start-up to prevent motors starting with initial load.

The water chillers of both machines are connected in parallel on the chilled water loop which is served by two 60 hp pumps with one 60 hp pump as a standby to provide greater flexibility. Any pair of these pumps is capable of pumping a total of 3000 gpm against the total dynamic head of the loop—with the centrifugal machines capable of cooling this amount of water from 55 to 45 F during design peak conditions.

Condensing water is supplied to the condenser of the centrifugal machines by two 75 hp condensing water pumps with standby similar to the chilled water loop. With two pumps capable of pumping a total of 3600 gpm, the condensing water circuit is completed by discharge from the pumps to the condensers, then to an induced draft cooling tower of all redwood construction located on the 10th floor roof west of the equipment room penthouse, and thence back to the suction side of the pumps from the water collecting basin at the bottom of the tower. The tower was selected for cooling 3600 gpm from 86 to 76 F with 70 F wet bulb.

The refrigeration system also employs safety relay interlocks which prevent the condensing water pumps from starting until the cooling tower fan is running, and both the chilled water pumps and the condensing water pumps have to be running with sufficient flow through the chillers established before the compressors can start.

Bypass damper under chilled water coil, and transition between fan discharge and hot and cold plenums. This equipment is in the third floor fan room



Cooperation Between Architect, Engineer

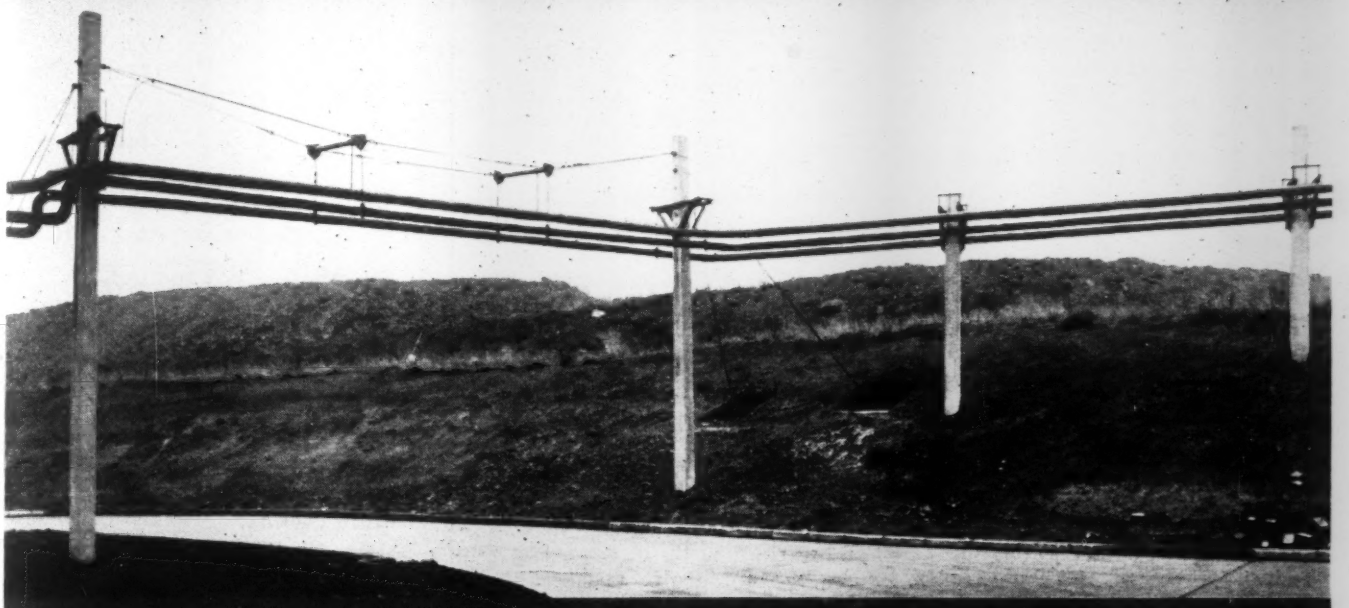
Underlying the entire new project is the close cooperation between architect and mechanical engineer. With the problems of the engineer in mind during the initial phase of design, the architect avoided unnecessary delay in erection which is so often the case when buildings are designed without regard to mechanical space requirements.

The new building exemplifies the latest of architectural advances. In effect, it is a proud example of "controlled" interior conditions to promote maximum efficiency for its working personnel. The extensive use of acoustic ceiling for noise absorption and modern "daylight" lighting fixtures, plus the positive removal and supply of conditioned air, made possible the extensive use of glass block and symmetrical stonework which provides a pleasing modern appearance.

The new Mirror building, Los Angeles, was designed by Rowland H. Crawford, architect, of Beverly Hills, Calif., with Holmes & Narver, Los Angeles, as structural and mechanical engineers. The general contractor is P. J. Walker Co., Los Angeles, with the installation contract for air conditioning and refrigeration being awarded to Western Air & Refrigeration, Inc., Los Angeles.

UNIVERSITY OF MICHIGAN LIBRARIES

HIGH PRESSURE HOT WATER



Details of Design and Operation

IT MIGHT BE said that the circulating pump is the heart of the high pressure hot water system, and thus the pump type and capacity need careful consideration.

Pumps have been specially designed for use with HPHW having the following features:

Suction intake shaped to avoid abrupt changes of direction or velocity, so as to reduce cavitation.

Casing usually of cast steel or bronze to withstand the higher pressures and possible shocks.

Gland and bearings water cooled and suitable for high temperatures.

Bedplate and mounting designed to permit expansion due to temperature, without causing strain or malalignment.

Fig. 1 shows a typical pump suitable for HPHW embodying the above points.

The pumps will, of course, be installed in duplicate, each of full capacity, or in the larger installations sometimes three may be furnished, each for 50 percent load, thus allowing some economy of power at periods of light load by the use of one pump at such times, two running normally with one as standby.

Calculating the Pump Capacity

Reference has been made in my earlier articles to the inclusion of a turbine pump for emergency use, also to the provision of a separate pump if water at two temperatures is required. It is usually possible, by suitable header and valving arrangements, to allow the standby pump to serve as a reserve for either duty.

The capacity of the pump is calculated from the total Btu load on the system, but as pumps are normally sized on a volume basis, one must be on guard owing to changes in density and specific heat of water at the higher temperatures. The calculation can be made using data given in the June HPAC, pages 97-102, or from Table 1 herewith. This table gives the Btu carried by 1 gpm of water passed by the pump, assuming the latter to be in the flow as advocated earlier.

J. R. KELL, member of the firm of Oscar Faber & Partners, consulting engineers, London, England, considers this month the pumps, piping, air valves, regulating valves, and control for high pressure hot water (HPHW) systems for process and space heating service. He concludes with a few remarks on starting up such a system. In the April, June, and August issues of HPAC, he wrote on fundamentals of HPHW, pipe sizing, piping design, piping layout, and boiler types. These four articles—plus additional comment in our "Open for Discussion" columns in various issues—give a well-rounded picture of HPHW and its application

The usual margin of, say, 20 to 30 percent over calculated load will, of course, need to be added before selecting the actual size of the pump.

The pump duty remains practically constant under conditions of mixing, since the bypass is taken into the pump suction with the pump in the flow, so that all the water handled by the pump passes to the system whether it has come via the boiler or via the mixing connection.

The pump head will be as calculated from the pipe sizing friction loss, for the index circuit, plus the resistance of the boiler (particularly if of the high velocity tubular type), plus the head necessary to pass the water flow through the last heat emitter on the system. The above will naturally have to include due allowance for bends and fittings, boiler and drum connections, piping in the boiler house, etc., as normally encountered in any water pumping calculation.

Table 1—Btu per hr carried by one U. S. gpm passed by pump in flow

Return temp., F	Flow temperature, F							
	230	240	250	260	280	300	325	350
200	14,400	19,100	24,800	28,450	37,600	46,500	57,660	68,50
210	9,600	14,350	19,100	24,800	33,000	42,000	53,200	63,80
220	4,800	9,600	14,300	19,000	28,200	37,300	48,500	59,30
230	.....	4,800	9,550	14,300	23,580	32,700	44,000	54,80
240	.....	.....	4,780	9,520	18,860	28,200	40,250	50,40
250	.....	.....	.....	4,760	14,200	23,400	34,800	45,90
260	.....	.....	.....	.....	9,500	18,750	30,200	41,30
270	.....	.....	.....	.....	4,750	14,100	25,600	37,80
280	.....	.....	.....	.....	.....	9,400	21,000	32,20
290	.....	.....	.....	.....	.....	4,700	16,300	27,65
300	.....	.....	.....	.....	.....	.....	11,700	23,15

Welded Piping Usually Used

HPHW systems have, as a rule, been usually erected with welded joints, using seamless solid drawn steel tubing. When this was sometimes unobtainable during the war, butt or lap welded tubing was in many installations resorted to, with apparently successful results, but under normal conditions the former is to be preferred, in my opinion.

Flanged joints appropriate for the pressures in question are used in the boiler house, and at valves, etc., elsewhere in the normal way, though welding valves are equally suitable. The flanges should be of steel.

It is usual to keep to flanged joints for valves controlling small items such as convectors and unit heaters, even though these be no more than ½ in. in size. The same applies to drain cocks and air valves. On the mains long radius bends and swept tees are desirable.

Piping should be graded (as with any hot water system) to about ½ in. in 10 ft, rising up to air collecting points and down to drain points.

The piping system will require testing in accordance with standard practice either in sections or as a whole.

Flexible loops or changes of direction should be arranged according to temperature, length of run, and permissible movement.

Supporting of the pipes calls for no special comment, as normal steam practice may be followed, allowing ample swing for movement and including spring hangers on lifts, etc., where necessary.

Dirt pockets should be included on the dips in the mains at low points, with a blank flange for completely emptying out, as well as a drain cock.

At all high points in the pipe lines, air will collect on the initial fill and subsequently at intervals. Air bottles are therefore necessary, as shown in Fig. 2, having the air pipe carried down to a valve in an accessible position.

Selecting the Proper Valve

The problem of selecting the best type of valve for the HPHW installation is a serious one.

There has been a good deal of trouble with valves failing to shut off when required, even though they have been of the best parallel slide

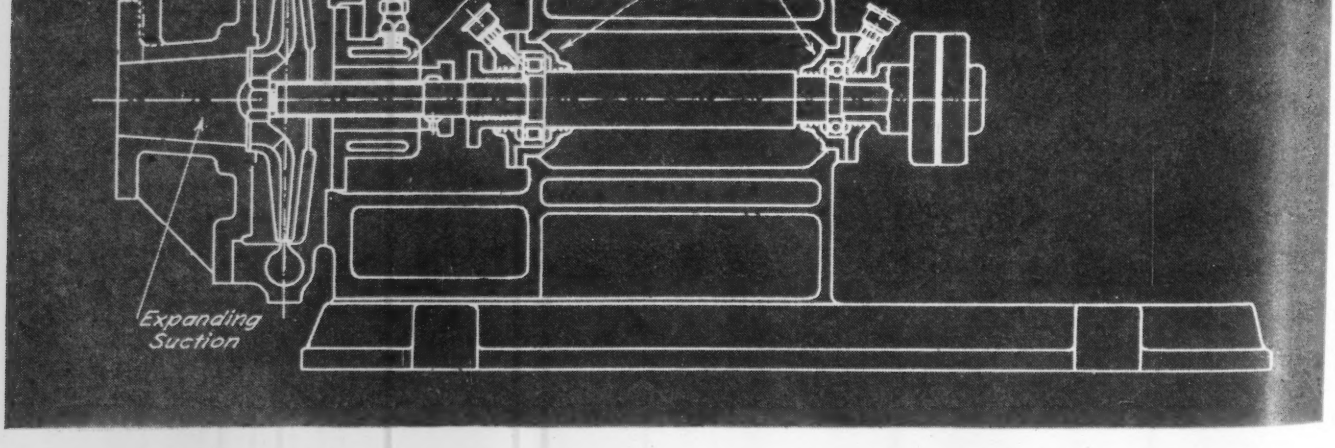


Fig. 1—Typical centrifugal circulating pump for HPHW systems embodying features as listed in the text

UNIVERSITY OF MICHIGAN LIBRARIES

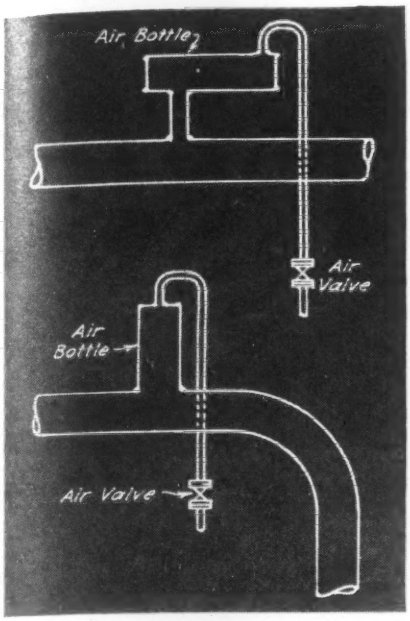


Fig. 2—At all high points in the piping, air will collect on the initial fill, and subsequently at intervals. Air bottles and valves are therefore necessary

type. This may be because adequate attention has not been paid to water treatment.

The tendency now appears to be toward the adoption of mushroom seated valves, preferably of the 45 deg angle type, which give an almost straight through passage, on the score that if deposits do collect on the seating faces, the pressure obtainable for closing is much greater with this type. One recently developed valve is shown in Fig. 3. As will be seen, it has a long gland and a base plug for cleaning out.

Large valves in the boiler house and on mains should have cast iron or cast steel bodies, according to the operating pressure, and small valves should be of bronze.

Valve glands for HPHW are usually longer than for steam, and some makers include a nipple for grease gun lubrication.

Thermostatic Control for HPHW

Methods of thermostatic control with HPHW differ from steam only in that control of temperature of flow to suit weather is achieved by regulation of a mixing valve at the boiler instead of by pressure or steam volume control.

Assuming a weather controlled mixing valve, the rest of the controls in individual buildings or rooms will have less work to do.

These further controls will probably take the form of on-off control of unit heater fans, or motorized valve control of convectors, coils, heat exchangers, etc. It is not desirable to open and shut valves suddenly in big mains, as might be the case in a zoned steam system, in view of the pressure changes and possible water hammer which might result.

Control of process equipment may also be performed automatically according to the particular requirements. Again, this would be by some form of motorized or modulating valve in the flow or return connection; the latter is preferable due to the lower temperature.

Gland seizure with thermostatic valves is sometimes troublesome, and here again (as for hand valves) some makers fit grease gun lubricators, which appear to be a successful adjunct.

For maximum economy of heat, all mains, valves and flanges whether inside the building or in trenches, on poles, or in the boiler house, require insulation. Pump bodies and headers should also be included.

The insulation may take any of the forms commonly used with steam systems, appropriate to the temperatures employed, and therefore needs no special discussion.

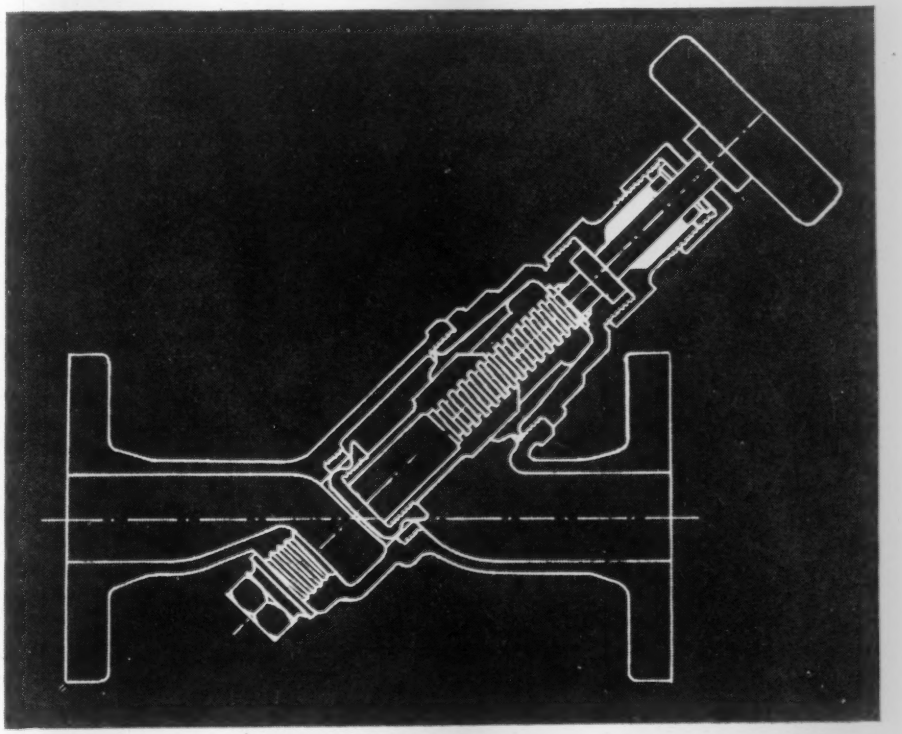
Assume the system is complete and filled up ready to start. The pump or pumps can be started, the boiler fire put on gradually at first, and the whole system brought up from cold to the pressure and temperature needed.

Starting Up the System

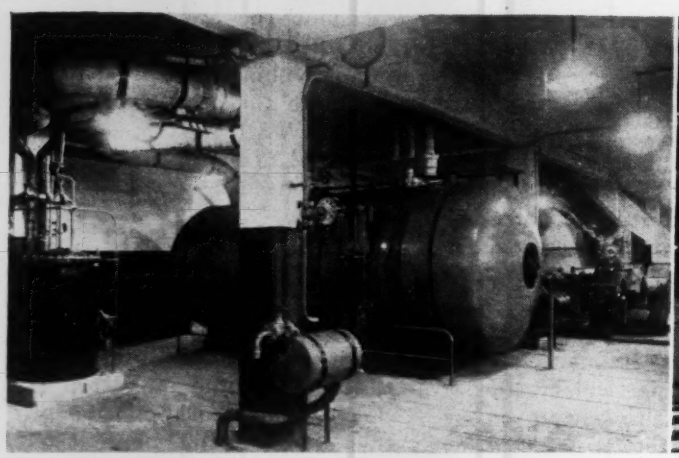
Alternatively, if the boilers are of the shell type, they may be warmed up to a moderate pressure with closed valves, and the return valves slowly opened to apply pressure to the system. The pump is then started against closed valves. Next, the boiler flow valves are opened and the piping gradually warmed up, still at a moderate pressure. Lastly, the mixing valve is closed down as required, and the boilers brought up to full temperature and pressure. Balance connections will be left open at all times except when a boiler is out of use.

If now we wish to shut off a section, it must be borne in mind that on cooling, the water will contract and with the lowered pressure may flash into steam. The flow valve only should therefore be closed fully to start with, leaving the return partly open until the section has cooled off, when it may then be shut fully.

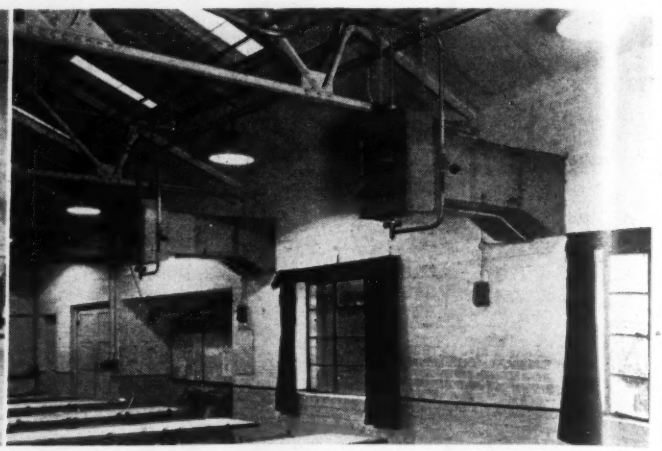
Fig. 3—Recently developed 1½ in. regulating valve having a long gland and a base plug for cleaning out



UNIVERSITY OF MICHIGAN LIBRARIES



Some of the piping and heat exchanger equipment for a HPHW system, showing air bottles



Horizontal type unit heaters, showing the HPHW piping connections

These articles on HPHW have been intended as an introduction to an interesting but possibly unfamiliar system of heating and process piping which has numerous advantages, and possibly some disadvantages—but which is capable of considerable future development, in the author's opinion.

With continued research it is felt that the problems associated with high pressure hot water should be capable of satisfactory solution (though the problems should not be exaggerated, as there are a host of examples of successful installations, both in Great Britain and on the European continent).

It has been the intention to show the main points of difference between high pressure hot water and steam, on the assumption that the latter was so thoroughly well understood, as to need no reference to the first principles underlying both; and further because it was assumed that steam would be the conventional method of tackling the size and kind of job we have been discussing.

Radiant Heating Pipes in an Extra-Thick Slab Reported "O.K."

Successful operation of a radiant heating system embedded in an extra-thick concrete slab was demonstrated last winter at a new motor freight maintenance and repair building in Columbus, Ohio. A heavy load bearing floor slab is needed in the new service building of Commercial Motor Freight, Inc., because it is used for repairing huge tractors and trailers. Architect Charles W. Cloud designed the floor slab 8 in. to 10 in. thick, resting on a 6 in. stone foundation fill and reinforced by a single layer of 6 x 6 mesh—No. 10 wire. Its bearing is 3000 lb per sq in.

The radiant heating system is laid out in nine grids that cover most of the 20,000 sq ft of floor space in the structure. Sinuous coil patterns are employed in two paint stalls and the office section. The grids are made up of 2½ in. headers with 1¼ in. grid pipes between. Spacing of the grid pipes is 18 in. center to center, except in front of the 16 ft wide main doorway where the spacing is reduced to 12 in. centers. All supply and return mains, ranging from 2½ in. to 4 in. in size, are run along the west wall that is exposed to the most severe winds. They are spaced 6 in. apart. The additional heat loss along the other walls is compensated by spacing the nearest three rows of grid pipes on 12 in. centers.

The welded wrought iron coils rest directly on small concrete footers especially put in to keep pipe level and embedded in concrete. Before the slab was poured, the reinforcing mesh was laid over the coils. Design temperature was calculated at 65 F for zero outdoors. The design engineer for the heating plant was R. W. Pirrung, Columbus. The Sauer Co. of Columbus fabricated and installed the coils. The entire piping system was tested under 200 lb air pressure before concrete pouring was started.

The boiler is located in a partial basement under the locker room. Two sectional boilers with combination oil or gas burners provide hot water for the system. So far, only oil has been used for firing. Water leaves the boiler at 125 F. A 5 hp 30 gpm centrifugal pump on the return main forces water through all nine grids, while two individual 1/6 hp circulators are used for the two zones that have sinuous type coils.

Automatic air relief valves are installed at all high points in the system which grades up slightly from the boiler room. At low points, drain valves and hose nipples are provided. Each individual coil has a balancing valve located in a box cast in the concrete and covered by a metal plate.

Despite the unusually severe weather conditions encountered after the building was completed in December, the radiant heating system functioned perfectly, Mr. Cloud reported.

The repair and service building is part of a large terminal development project undertaken by Commercial Motor Freight, Inc. It includes a 310 ft by 44 ft freight dock, office buildings, and large truck and trailer parking areas.

Hospital Suggests Unusual Ideas on *Heating and Air Conditioning*

***JOHN D. DILLON** and **R. P. GOEMANN**, New York City, formerly of the office of Phillip M. Gussow, consulting engineer,*

describe the features of the heating, ventilation, and air conditioning design for a large new hospital. In explaining the problems encountered and how the design adopted meets them, a number of ideas which would seem to be of interest not only in hospital but in other big building work are brought out

AIR CONDITIONING, heating, and ventilating problems of considerable interest—the solutions for which offer ideas which can be employed in other types of buildings—were met in the design of the mechanical services for the new General Hospital, between 97th and 99th Sts., and 1st and 2nd Aves., New York City.

The main building of the structure is 16 stories in height with two floors of fan and elevator machinery rooms and water tanks above that in the tower section. There is also a seven story outpatients and interns dormitory section. The hospital includes tuberculosis, surgical, medical, and maternity wards, premature and normal nurseries, operating and delivery rooms, x-ray, fluoroscope rooms, contagious disease section, outpatients clinic, classrooms, consultation rooms, shops, rehabilitation shops, interns quarters, apartments, theater, kitchen and dining rooms. The proper integration of the medical functions of the building forced the boiler room out under one of the eight story wings. This necessitated underground breeching from this section to the 18 story section.

From a heating engineer's viewpoint, the particular complicating factors are the high glass content of the building, an 11 ft limit on floor height (that is, 11 ft from floor to floor), and a ground water condition with water 8 in. under the basement floor. One foot extra headroom on the top floors of each section where the heating mains run and an extra foot on the operating room floor were allowed for the heating design.

Air conditioning is limited to the operating suite, delivery rooms, premature nurseries, and the board and conference rooms. Supply and exhaust ventilation is provided for the nurses' stations, nurseries and waiting rooms, contagious disease rooms, animal rooms, and classrooms. There is exhaust ventilation for the toilet and shower rooms, cleaner's rooms, and certain of the treatment rooms.

Since the air conditioning and ventilating equipment took up the most space, the first approach in the design was to the air conditioning systems. The operating rooms—largest of the air conditioned areas—take up the complete 10th floor. They are thus subject at some time of the day to the sun's rays on every exposure.

Suggestions for outside screens or awnings were considered but were rejected—the screens, because of the difficulty of cleaning them 10 floors up in the air; and the awnings or shutters because of appearance and the maintenance cost due to high winds. With no other means of excluding solar heat, various combinations of glass were investigated.

Reducing Solar Heat Gain

Since the sun rays shine directly in on the operating areas, it was necessary to devise some method of excluding the direct light of the sun as well as the heat. In the approach to the problem, various types of heat absorbing and light diffusing glasses and glass blocks in various combinations were studied. In addition to excluding light and heat rays of the sun, the problem is complicated by the necessity of maintaining 80 F dry bulb and 60 percent relative humidity in winter as well as summer.

An architectural objection to glass blocks was that they would break up the continuity of the glass windows, a principal feature of the building. Heat absorbing glass, with an inner wall of light diffusing glass, was proposed. This was objected to because of the color of the heat absorbing glass; it was felt that the sun rays shining through this glass might cause an unnatural coloration on the skins of the premature infants and mislead the nurses or doctors about the infants' physical condition. This objection brought us back to glass block for the premature nurseries; since it was to be used there, it was decided to use it in all conditioned spaces. The interior glass wall is made of removable glass panels.

In the original study of the composite wall of heat diffusing and light absorbing glass, it was decided to exhaust the air from the conditioned space through the plenum created by the double glass wall. Since 100 percent of the air exhausted from the operating rooms must be wasted, it was felt that using the 80 deg air would cool the space in summer and heat it in winter and would always tend to maintain the plenum space at the room condition.

It was proposed that the radiator be placed in this between-glass space. This then gave a condition for which the architects were striving; that is, an operating room with no interior projections or dirt catching pockets. The re-use of exhaust air will take almost all direct sun heat from the inner face of the glass

blocks and maintain a wall, in the summer with the sun on it, at 5 to 10 deg above the room temperature.

Automatic Dampers Prevent Condensation

In winter, the high humidity air will help heat the plenum space until the outside temperature goes to 30 F. At about 26 F, condensation would start to form, so automatic dampers were arranged to operate with an outdoor thermostat so that when the outside temperature falls below 30 deg, the plenum space will be closed off and the air exhausted through the sterilizer rooms.

A small portion of the room air is exhausted at all times from the ceiling in case lightweight anesthetics are used.

The question was brought up as to how serious the condensation problem actually was. Weather charts for a severe month were investigated and it was found that on 17 out of the 28 days in February, the temperature in the morning did not exceed 26 deg, giving an almost continuous condensation problem.

The double glass wall is thus as effective in winter (or for most of the winter) as in summer. This scheme—so frequently used in process work but too infrequently used in institutional work—of re-using waste products to regain the heat from them should show worthwhile operating savings.

The double glass wall is used in the operating rooms, premature nurseries, delivery rooms, and septic maternity section. The labor rooms were excluded from air conditioned sections. Probably the point should be emphasized that the air conditioning in this hospital is provided mainly to increase the humidity. High humidity decreases the possibilities of explosions in the operating areas. High humidity in nurseries keeps weight up in babies and aids the premature infants to a better start in life.

The general ventilation scheme used is six air changes for unimportant interior rooms without odors, 10 changes for important interior rooms and exterior foul odor rooms, and 15 changes for interior foul air rooms. Of course, the city code on ventilation is the criterion as far as minimum air requirements are concerned.

The ducts are taken up three or four floors at a time and then carried to the main ventilating shafts. Taken a few floors at a time, space can be found to fur in the horizontals. If the vertical ducts were carried up six or eight floors before getting to the main vent shafts, the resulting horizontals would be excessive in size. Then, too, the collection of the ducts three or four floors at a time reduces the possibility of chimney effect. There are six main vent shafts extending from the lower floors to the various fan rooms, which are in penthouses adjacent to the elevator machinery.

To eliminate as much as possible any airborne bacteria in the various air conditioning and ventilating systems, all entering air is washed. The washers serve a double purpose, humidifying the air as well as cleaning it. The air conditioning rooms (which are generally interior spaces) were kept to a minimum so as not to use up expensive cubage.

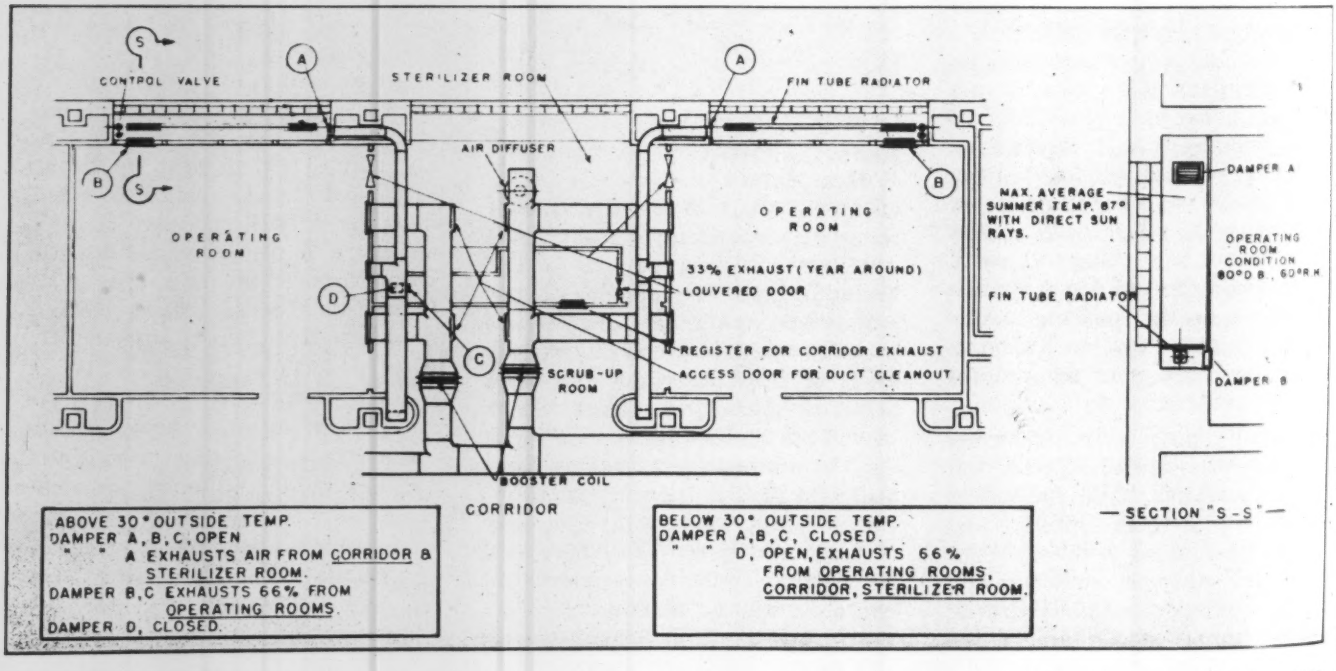
Vertical Air Washers Conserve Space

The length of these rooms is generally restricted by the length of a bay. The narrow width and fixed length prevent a conventional horizontal washer and fan set up. To meet the space conditions vertical washers with double inlet fans set in the ducts above the washers are used. This saves about 30 percent space over the conventional horizontal layout. There are, of course, the customary banks of filters ahead of the washers.

In addition to the washers and filters, sterilizing lamps are provided on the incoming air for the nurseries, operating rooms, and contagious wards. They are provided with 25 percent excess lamps so that several lamps can go out without lessening the efficiency of the installation.

The contagious section received

A double glass wall—room air being exhausted through the plenum space thus created—is used for the operating rooms (and other spaces). To prevent condensation, automatic dampers are arranged so that when the outdoor temperature falls below 30 deg, the plenum space is closed off and the air is exhausted through the sterilizer room



UNIVERSITY OF MICHIGAN LIBRARIES

special ventilation treatment. Slight negative pressure is to be maintained in all the rooms. The air will be washed, sterilized, and humidified at entrance. The possibility of the air discharge at the second floor level from the contagious disease rooms containing bacteria is met by batteries of sterilizing lamps placed in the ducts to sterilize the air before discharging to atmosphere.

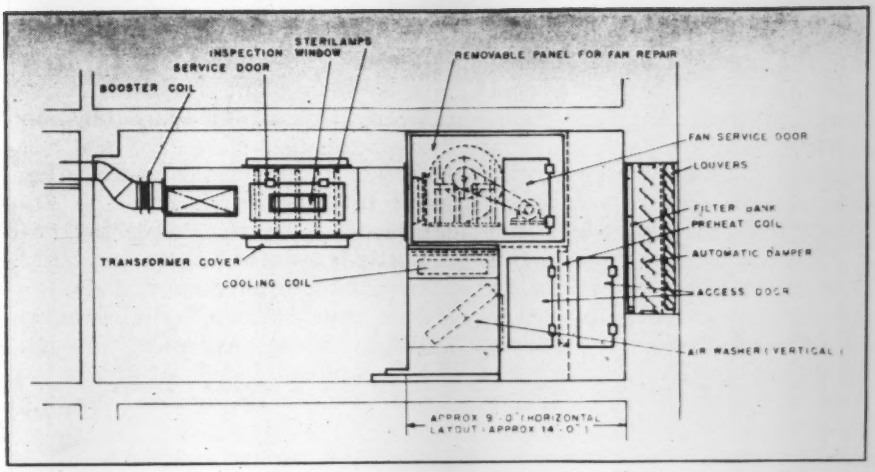
Removable panels are set at any points where equipment is concealed in walls or ceilings, particularly in the scrub-up and sterilizing rooms adjacent to the operating rooms. Provision is made in the ducts for cleanout doors through which the air ducts from the heater coils to the room outlets can be cleaned.

School type unit ventilators are used to bring in outdoor air to the scattered spaces not served by the central systems. When 100 percent outdoor air is required (as in the kitchens) steam risers are run to the unit ventilators; when relatively small quantities of air are required (as in some of the classrooms, etc.) the unit ventilators are installed on the hot water system with recirculating dampers.

Downfeed Hot Water Systems

The main hot water heating systems start from converters in the elevator machinery and fan room floors, the distributing mains running around the top floors and downfeeding through risers at each column. The main distribution of heat will be achieved with fintube radiators 2 ft above floor level which fit under perforated window sills. One tube high is used throughout. On the day porches, where there are large glass areas, the lower parts are of the double pane, sealed in air space, insulating type. The use of fintube radiation leaves the floors clear of any piping and minimizes the dirt catching areas underneath. The fintube used is 2 in. tube with ½ in. fin spacing.

Each radiator has a 150 lb stop valve on the intake and a 150 lb choke valve on the discharge. The temperature drop through the tube is about 16 deg for the standard 15 ft radiator with 2 gpm flow. The heat transfer could have been increased by increasing the flow but the heat gain did not compensate for the increased pipe sizes necessary.



Because of space restrictions, vertical air washers with double inlet fans set in the ducts above the washer are used

The main hot water heating system was figured at approximately 245 F flow and 230 F return. All sections of the building are downfeed with the flow mains concealed above the ceilings on the top floors. All circulation is by reversed circuit mains so that equal paths of friction make for a minimum of adjustment of the choke valves on the returns. The risers are designed for about 4 ft velocity (in a few cases approaching 5 ft) and use ¾ in. pipe as a minimum.

The supply mains are sectionalized so that 4 in. diameter is the largest pipe concealed above the hung ceiling. The hung ceilings are composed of large panel sections which are easily removable.

The return mains are run for the greater part at the basement ceilings and all follow the flow mains to reverse completely all circuits. The returns are brought back to the converter rooms at the top of the building. The returns go through the circulating pumps to the converter, or bypass it under the control of three way valves. The converters are maintained at a variable temperature fluctuating in accordance with the outside temperature to minimize the hunting range of the three way valve. The heating medium in the converters is low pressure steam.

Radiant Heating for Tuberculosis Floors

The radiant heating system for the tuberculosis wards (which occupy the 11th through the 15th floors) is split in two parts. The north section of the center wing covers the 11th through the 14th floors while the south section covers the 11th through the 15th floors.

The discussions put the coil in the slab and out. The final decision was against pipe in the slab for several reasons, the principal one being the increased load on the foundations. Pipe in the slab means a solid slab instead of a filler block slab and is approximately a 50 percent heavier slab with a resulting heavier load.

The final coils were arrived at by much the same process of elimination. Three-fourths and 1 in. pipe hung below the slab would call for 1½ to 2 in. of plaster. This was added expense and weight, so again fitting the design to the most economical ceiling, it ended up as ⅜ in. copper tubing against the slab in the plaster. The ⅜ in. tubing was figured on 6 and 9 in. centers and the coil length calculated to come within the temperature drop and head permitted by the installation.

The radiant heating flow mains are carried around the 15th floor ceilings alongside the standard heating mains and the risers down feed to the coils. The risers and coils are so designed that air is vented to the flow mains and no pockets are left to trap air. The return from each coil is provided with a stop and waste valve which also serves as the balancing choke. As in the standard heating system, the reversed flow principle and equal friction path sizing is used. These systems should balance out very easily and there should be no long drawn out adjusting and readjusting of the choke valves.

The heating and air conditioning controls comprise a complete pneumatic system—or, rather, a great number of them, each air conditioning system and each converter pumping unit being under separate controls. The controls feature outside-inside bulbs, relay panels, motor operated dampers, and valves.

The boiler room—except for the package type water wall boilers—also follows conventional lines with deaerating heaters, boiler feed pumps, forced draft fans, domestic hot water heaters, controls, etc. Possibly more turbines than usual in a small plant are used. They are used on all forced air fans, on one boiler feed pump, and one fuel oil pump. All exhaust steam from the turbines is fed into the low pressure main that feeds the domestic hot water heaters and other low pressure equipment and also the deaerating heater. The exhaust main vents to atmosphere through a back pressure valve set at 5 lb.

Because of the need of limiting ceiling heights, the conditions of design were unusually difficult and problems developed that required careful planning. Difficulties encountered in the work were solved through the excellent cooperation of Louis Viola and Fred Bernhard of the designing architect's firm of Charles B. Meyers, in collaboration with Albert Bauer and Louis Axelbank of the New York City Department of Public Works. Phillip M. Gussow is the consulting mechanical engineer.

Pipes Pulverized Coal for Standby Fuel

The "largest capacity circulating system ever built" for firing pulverized coal has passed initial operating tests and goes into service this fall.

The system, first of its kind in the cement industry, was designed as a standby fuel supply for kilns of the Universal Atlas Cement Co. at Independence, Kan. It has been tested during the past few months and is ready for use during the winter when the supply of natural gas is frequently inadequate.

The system has a continuous loop of piping 275 ft long overall through which the coal and air mixture from a single pulverizing unit circulates continuously to the plant's four rotary kilns. Operation has proved successful in complete coal firing of from one to three kilns at one time and it is possible that further experimentation with a combination of natural gas and pulverized coal in the pipe may make it possible to fire all four kilns simultaneously with a mixture which is up to 75 percent pulverized coal.

The coal mill is a large single race pulverizer; it is 12 ft high, with a windbox which has a 9 ft, 10 in. outside diameter. Capacity of the mill is rated at 18,250 lb per hr of coal at 50 grindability to 80 percent minus 200 mesh fineness.

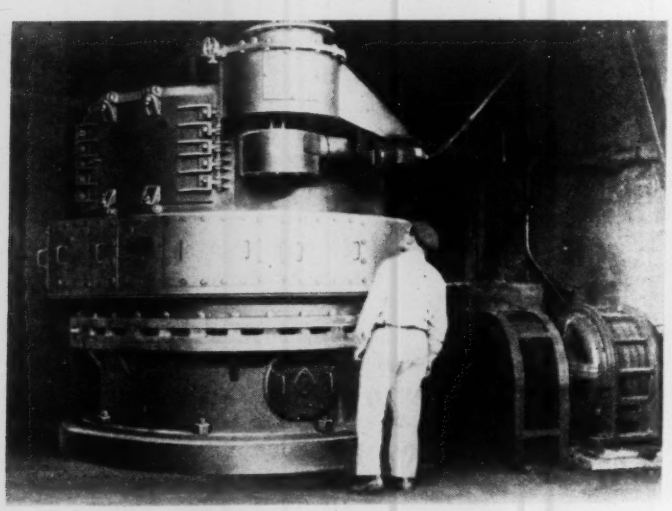
The system was designed for simultaneous firing of two kilns with a peak fuel demand of 15,240 lb per hr of pulverized coal, but with normal kiln output and fuel demands and with average quality and grindability coal, the system meets the requirements of three kilns at once.

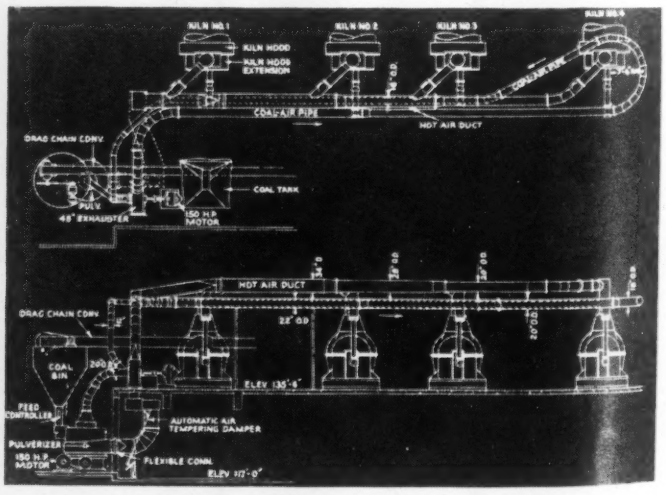
The distributing pipe line operates with a surplus of primary air-coal mixture which is recirculated back to the pulverizer exhaust fan. The diameter of the pipe line is progressively smaller from beginning to end to compensate for successive removals of fuel for the kilns of the line. Feeding of coal into the pulverizer and discharge of pulverized coal into the pipe line are controlled automatically. The circulating system which eliminates storage of pulverized coal is constructed to remove fire hazards and is designed to withstand an explosion pressure of 50 psi. It has a safety factor of four and should an explosion occur the fire is carried on through the burner pipes to the kilns where it is harmless.

With successful operation of this installation, the field for economical application of pulverized coal as a fuel is expanded, and the practicality of loop lengths up to 1000 ft is indicated. The direct fired circulating system is said to be particularly valuable where there are many furnaces of small capacity located some distance apart. This is true in the chemical, cement and lime, and metallurgical industries.

[Illustrations courtesy The Babcock & Wilcox Co.]

The system has a continuous loop of piping through which the coal and air mixture from a single pulverizing unit circulates continuously to the plant's four rotary kilns





UNIVERSITY OF MICHIGAN LIBRARIES

F. F. STEVENSON and JACK F. SALSBURG, designing engineers with wide experience in the air conditioning of industrial and other types of buildings, have stressed in previous articles the importance of coordinating the architectural and mechanical designs. They get down to cases here, explaining and illustrating various possibilities for installing air conditioning equipment in larger industrial structures with truss roofs

INDUSTRIAL AIR CONDITIONING

Equipment Arrangement with Truss Roofs

PREVIOUS ARTICLES on this subject have considered industrial buildings of moderate size, of one or two stories, with concrete slab roofs and suspended ceilings and have presented some ideas for the design and installation of air conditioning facilities. This month we attempt to treat the air conditioning of larger structures, with truss roofs.

Truss roof construction with spans of 60, 70 and 80 ft and even longer is in wide favor with architects and structural engineers and lends itself very well to the installation of air conditioning systems. A typical trussed roof building of large size usually will have a main floor and basement. It may or may not have mezzanines or monitors located on the roof. Monitors do not fit well into the present trend of windowless, mechanically ventilated and air conditioned buildings. Mezzanines, however, may be a worthwhile architectural feature. The main floor of our typical building may or may not have a ceiling suspended from the truss.

The air conditioning of such a building, either for comfort or process requirements, involves the installation of machinery having considerable weight and bulk, especially if large central station systems are used. Therefore, the location of such equipment is an item of major importance to the architect and structural engineer. Not only the machinery itself, but the piping and ductwork leading to and from it, must have the advantage of sound planning.

One of the first decisions to be made by the designer is whether the air conditioning system shall be the central station or multiple type. In other words, shall the system consist of one (or perhaps two or three, depending on the size of the building) large unit or shall it be broken up into a number of small units located at strategic points throughout the structure? The pros and cons involved in this decision have received the attention of several able engineers during the past

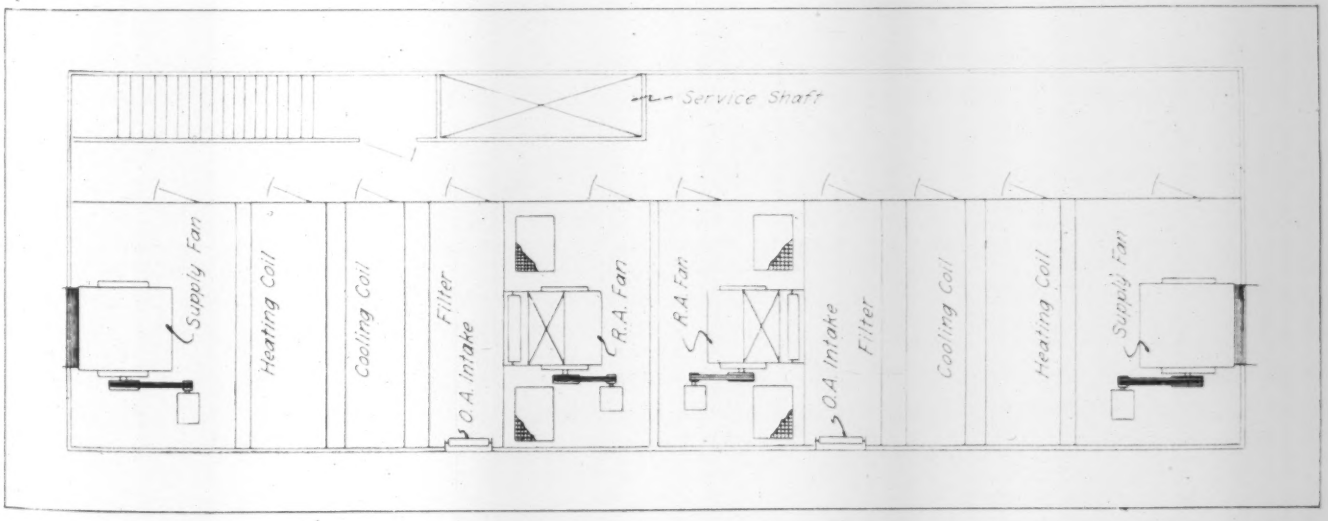


Fig. 1—Plan of equipment arrangement with air treating unit in the truss space and projected through the roof

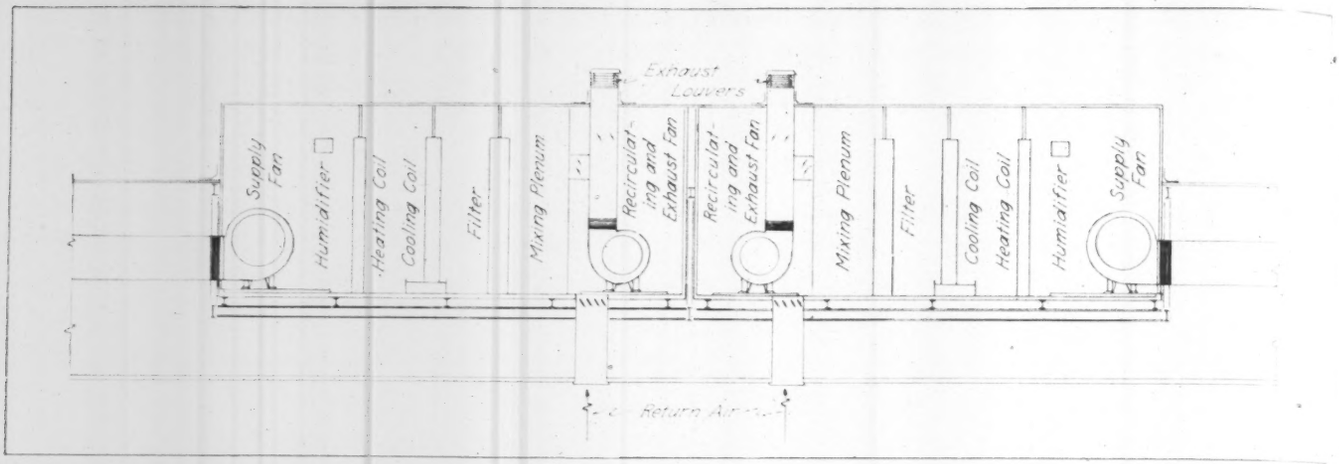


Fig. 2—Sectional view of arrangement of equipment for the scheme shown in Fig. 1

few years and this article cannot hope to improve on their findings and recommendations.

In some cases there is enough low temperature well water available to meet the needs of comfort air conditioning, so there is no problem of refrigeration machinery. However, if there is any doubt of how long the supply of well water will last, the original design and plans should provide for a quick and practical means for a change-over to refrigeration, earmarking the space needed for both machines and pipe lines. (And not forgetting that it may be necessary, if large refrigeration machines are used, to install heavy cooling towers on the roof.) Even if well water is available for comfort conditioning, it may be necessary to employ mechanical refrigeration to meet the demands of manufacturing processes.

Locations for Conditioning Equipment

In the plans for the installation of air conditioning systems, various locations for the equipment must be considered. Consideration will be affected by a number of variables: Will there be a mezzanine section, are penthouses desired on the roof, will the main floor have a suspended ceiling or none at all?

The locations to be considered are:

1) The basement.

2) One or more mezzanines.

3) Roof penthouses.

4) Air conditioning units lying partly in the truss space and projecting through and above the roof.

5) Air conditioning units wholly in the truss space.

The first considerations for any location are: Is there enough space, considering the bulk of the equipment, and can its weight be supported? If it is necessary to increase the size and weight of supporting members, this should be incorporated in the design at an early date. By enough space is meant, Can the various air conditioning units be serviced easily? The next factor may well be ease of installation with regard not only to the original job but to replacements. When installation is made difficult and laborious, costs go up rapidly. Third, is such equipment using space which might be devoted more profitably to production? Fourth, will the installation housings mar the exterior perspective or profile of the building? Fifth, will the location make for economy in pipe and air duct runs? This last is important to costs, because insulated piping and sheet metal ducts are expensive items. The designer should be liberal in the number and sizing of service shafts for pipe and duct work.

1) *Basement location*—If a central station system is to be installed, certainly the refrigeration machinery should be in the basement, with the cooling tower on the roof directly above. In buildings of this size, when we speak of central station systems, we assume that the cooling medium will be chilled water, although direct expansion systems are often used. A large water chiller may be 1000 ft away from some of the air treating units, so the supply and return piping layout should get careful attention. Air treating stations may also be located in the basement, but there are numerous disadvantages in such an arrangement, principally because intake and exhaust air duct risers must be run between roof and basement and the duct system in general will be longer and involve more structural complications. If a multiple station system is to be used, multiple units may be located in the basement, especially if the refrigeration machine is included with the air treating unit, but the same disadvantages mentioned above apply here also.

2) *Mezzanine location*—This is a satisfactory location for air treating stations, with large refrigeration machines in the basement, or for housing complete multiple units including the refrigeration machine. However, it may be subject to the criticism of using high priced production space.

3) *Roof penthouse location*—This is satisfactory, either for complete multiple units or for air treating stations. However, in modern design, roof penthouses may not be good locations from the standpoint of good architectural design.

4) *Truss space location, with air treating or complete multiple stations lying partly in the truss space and projecting a few feet above the roof*—Such installations are widely used, especially where headroom in the truss section is not great enough to accommodate the necessary equipment. It is satisfactory from a utilitarian and performance standard and uses nonproductive space, but like location No. 3, it may not be a success with regard to architectural design.

5) *Truss space location with air treating or complete multiple stations lying wholly in the truss section*—This is a very satisfactory location if practical from a struc-

UNIVERSITY OF MICHIGAN LIBRARIES

tural and installation standpoint. It uses nonproductive space and there are no unsightly penthouses or projections marring the roof perspective. Unfortunately, lack of headroom has prevented truss space from being more widely used. However, for buildings with truss spans of 70 or 80 ft and longer this may be entirely practical. It may be necessary to make compromises in the height of fans, coil sections, and filters, but frequently this can be done without affecting the performance of the equipment.

To sum up—locations Nos. 3, 4, and 5 use nonproductive space but Nos. 3 and 4 involve specially built structures on the roof or projecting through the roof. Of course, with proper design and planning such structures need not infringe too much on the design and appearance of the building.

Locations Nos. 3, 4, and 5 are on or close to the roof, which is desirable for air treating equipment because of the ease of making air intake and exhaust connections. If smaller multiple units with refrigeration machines are used, these locations make it convenient to locate an evaporative condenser or a mechanical draft cooling tower adjacent to or directly above the refrigeration compressor.

The Use of Penthouses

In using location No. 3, the designing engineer may note the following: A type of penthouse wall should be provided that will allow exhaust and intake louvers to be installed easily at any point desired. The penthouse must be structurally sound and tight. Where fan plenums are used, such plenums must be airtight.

The penthouse floor is usually of concrete with curbing. Floor drains should be provided both inside and outside of the air treating unit, to provide for both the cleaning and draining of equipment and washing down the station platform. An insulated concrete drip pan should be placed under the cooling coil, for it is not desirable to let the condensation of the coils drip continuously on the concrete floor slab. The drip pans should be placed far enough downstream from the coils so as to catch all entrained moisture. The coils may be hung above or mounted directly in the pan. A drip pan for the humidifier may be incorporated with the cooling coil condensate pan, or a separate one provided. Ample access space and doors must not be neglected.

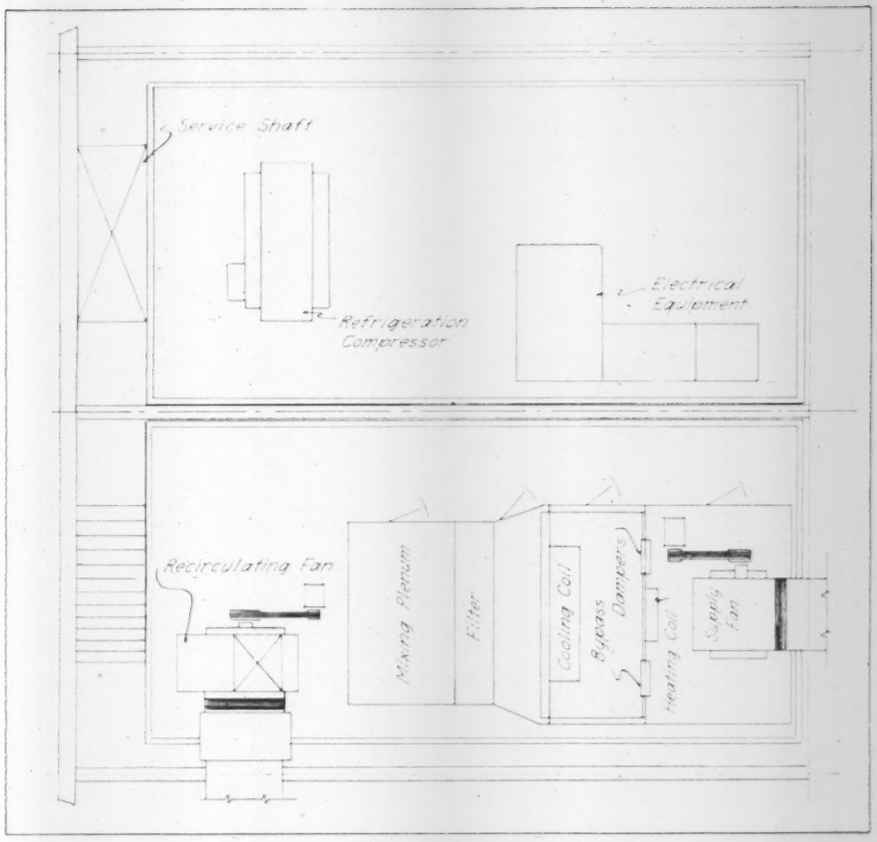


Fig. 3—Plan view showing location in truss space of multiple air conditioning unit and electric load station

In using location No. 3 the ducts, both supply and return, may be run through the truss space as described below. The weight of the penthouses must be thoroughly checked, as well as the weights of other equipment—such as evaporative condensers and cooling towers —which is to be placed on the roof.

Use of Truss Space

Many truss roof buildings have no main floor ceiling and in this case locations Nos. 4 and 5 are very desirable. Supply ducts leading from the station may be run below the lower truss chord with ceiling diffusers or horizontal discharge outlets. Return ducts may be eliminated entirely with a return or exhaust inlet at each station. This makes for a simple and inexpensive duct layout.

If there is a suspended ceiling, and enough headroom, the ducts may run between the lower chord and the ceiling, with appropriate supply and return openings in the various spaces or rooms. This will also make for a simple and inexpensive duct layout. In running ducts through such furred spaces, be sure to check sources of heat gain (such as steam or hot water piping).

If the space between the truss chord and suspended ceiling is not deep enough, the ducts must be run through the truss space. This is a task which requires careful layout work, especially if the ducts are large.

Also, the various structural members must be sized so that they are capable of supporting the weight of sheet metal. This means greater size of the truss members than would be ordinarily required. While running ductwork through trusses means high installation costs, the advantages of a truss location will in many instances outweigh such factors.

In running ducts through truss space, the designer has the choice of running the mains parallel with the trusses and the branches through the truss members, or vice versa. The location of air outlets is the determining factor.

Each station may serve the needs of an area, the length of span by a certain number of bays. It may be

possible to handle areas of from 15,000 to 20,000 sq ft with one station. Truss sections with spans as short as 60 ft may also house air conditioning stations, but headroom will be at a minimum.

A modern trend of design is to include the apparatus comprising an electric substation at the air conditioning station. This makes a practical installation in many instances. However, means will have to be provided to dissipate the heat from the transformer.

Check the Truss Loads

In using locations Nos. 4 and 5 the designing engineer should check the truss load and design and size the structural members accordingly. He should also check the headroom and size the air conditioning equipment to suit the space available. Double width, double inlet fans, by reason of their lower height, will work out better than single width, single inlet fans. Height of filters and coils must be scrutinized, also. If there is enough space for the air conditioning equipment, the electrical apparatus can usually be accommodated as well.

The floor of the unit may be a concrete slab or a deck of steel sheets. The latter will be much lighter in weight and probably lower in cost. However, using concrete, a curbing may be poured integral with the floor slab. Also, a concrete floor may make a better foundation for the equipment. The previous remarks about drainage and drip pans apply here, too.

In using location No. 5 it may be possible to build the unit with its platform on the ground, secure all the equipment in place, and hoist the complete assembly to its assigned location. If a concrete platform is desired, the concrete slab can be poured much easier with the unit on the ground and other savings can be effected as well. However, the weight of these stations may make the task of hoisting them in place a formidable one. The weight of the stations with the equipment—especially those handling air in the order of 20,000 cfm or more—is considerable.

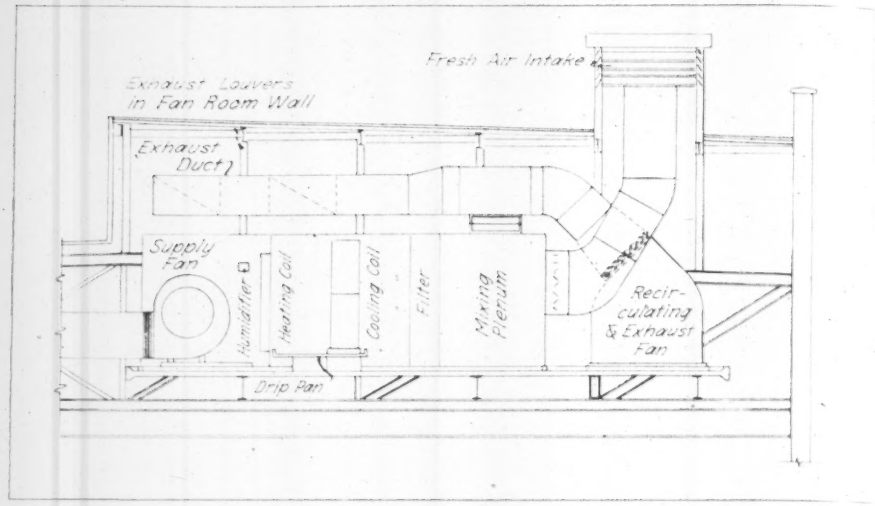


Fig. 4—Sectional view of an equipment arrangement similar to Fig. 3

A platform of reinforced concrete will weigh from 15 to 25 tons. A steel deck platform will weigh from 4 to 6 tons. This does not include the weight of the supporting beams. Altogether, the additional weight involved in erecting a large station may run to 20 or 30 tons. To the weight of the platform and supporting beams must be added the weight of the equipment. This may easily run to 5 tons and if items such as unit dust collectors and dehydrators are included, it will be considerably more.

When planning to locate a station in the truss space, it will be noted that by using the space of a typical 20 ft bay, and with a platform 40 ft long, a station handling up to 30,000 cfm of air can be installed. There must be sufficient access space, and room for two fans, supply and recirculating or exhaust, and the various coil banks and filter. Suitable catwalks and stairways must be provided.

Getting air supply to the areas directly under such a unit station may be a problem, for the supply ducts must backtrack to get access to these spaces.

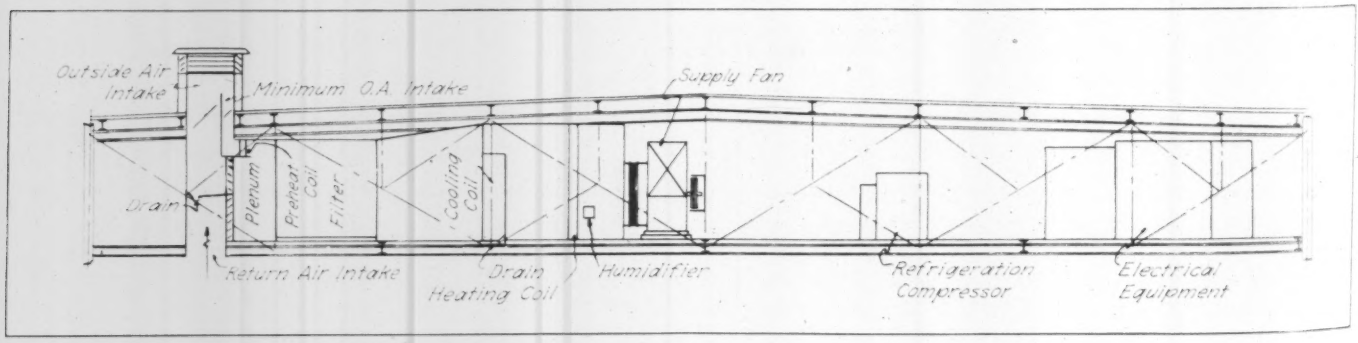
Fig. 5—An arrangement for location of the air handling equipment, refrigeration compressor, and electric load station in truss space

Drawings Show Various Arrangements

Figs. 1 and 2 illustrate the use of location No. 4, with the air treating unit located in the truss space and projected through the roof.

One or any number of these units can be installed depending on the size of the building. The station may house only the air treating equipment, or additional space may be provided for the refrigeration machines as well. Return air is taken into the unit through very short duct runs. Longer and more elaborate return ducts may be used if required, especially if the building has a suspended ceiling under the truss chord and if the air conditioned area is divided up into small partitioned spaces. Fig. 2 illustrates the return air arrangements, in this case through short duct runs from the suspended ceiling directly below.

Note the outside air intakes on the



UNIVERSITY OF MICHIGAN LIBRARIES

side wall of the mixing chamber and exhaust outlet above the unit roof. Two fans are used, the recirculating fan handling the return air and delivering it either to the mixing chamber or exhausting it to atmosphere. As the supply fan must maintain a negative pressure in the mixing chamber, the recirculating fan must discharge air at a very low pressure and be powered and sized accordingly. No preheat coil is used, as the unit receives a mixture of return and outside air, with the temperature of the mixture never approaching freezing. The outside air intake louvres should be up as high as possible, especially if the building roof is to be sprayed to reduce the sun heat load.

Figs. 3 and 4 show another arrangement using location No. 4. This is a combination multiple unit and electric load station. Note the arrangement for the recirculated and exhaust air and the outside air intakes. Arrangements should be made to dissipate the heat from the compressor motor. The electrical load station serving a typical area will have a capacity of from 300 to 500 kva and will include an air cooled transformer, a main breaker, feeder breakers, and a primary switch. As mentioned before, means will have to be provided to dissipate the heat from the transformer.

Fig. 5 shows the use of location No. 5 with a multiple station, including the refrigeration compressor and the electrical equipment. Note the outside air preheat coil.

Dehumidifiers Protect Priceless Documents

As part of the elaborate measures designed to protect such priceless documents of American freedom as the Constitution, Declaration of Independence, and Bill of Rights while on tour with the Freedom Train, 12 dehumidifiers have been installed in the three document cars of the train, according to the Frigidaire Div. of General Motors Corp.

Four of the units have been placed in each car and concealed behind the panels displaying the documents. Two have been placed near each car door to dehumidify the entering air. This reduces the amount of moist air in the main part of the car where the majority of documents are displayed.

In making the installation, certain requirements had to be met. Relative humidity could not rise above 70 percent nor drop below 40 percent. The dehumidifiers have maintained an average of 55 percent and inside humidity has not risen above 69 percent even though outside it has been as high as 95 percent.

To condense the moisture from the air, the dehumidifiers use a refrigeration principle similar to that of household refrigerators. Air is pulled into the dehumidifier by a fan. It then crosses a chilled refrigeration coil where the temperature of the air is lowered below its dew point. Moisture in the air is thus condensed and collected beneath the dehumidifier in a special container.

Since the dehumidifiers require no special connections and operate on standard 110 volt current, they may be used at will. Whether the Freedom Train is enroute or on display, all that is necessary for operation is to plug the units into wall sockets. Current from either the train power plant or an outside line is used.

Due to their portability and absence of intricate controls, the dehumidifiers may be moved to any part of the train if humidity rises above the danger point. Thus, the priceless documents that protect our basic liberties are safeguarded.

Sponsored by the American Heritage Foundation—a nonprofit, nonpartisan organization—in cooperation with the United States government, the Freedom Train is part of a year-long "national rededication" program. The program has been conceived to emphasize the basic freedoms of the United States to its citizens. Its slogan is "Freedom is Everybody's Job."

Inspecting a dehumidifier on the Freedom Train, 12 of which are installed on the three document cars to protect the priceless documents from moisture

SCREENS REDUCE TURBULENCE IN DUCTS

Extensive experimental research under the direction of G. B. Schubauer and W. G. Spangenberg of the National Bureau of Standards has led to a more complete understanding of the effect of damping screens in wind tunnel wide angle diffusers. Results have shown that the usual undesirable turbulence in such rapidly expanding ducts can be greatly reduced by suitable location of fine wire screens. Thus, wide angle diffusers may now be utilized for increasing the cross section of an air stream within a very short length of travel.

Complete details of this work are described in NACA Technical Note No. 1610, by Messrs. Schubauer and Spangenberg.

UNIVERSITY OF MICHIGAN LIBRARIES

Steam Drives for Refrigeration Improve the Plant Heat Balance

TERRY MITCHELL, mechanical engineer, Frick Co., Waynesboro, Pa., briefly describes here the application of modern steam drives for refrigerating and air conditioning service. He confines his discussion to summarizing some of the features of a few of the recent installations

EVER SINCE James Watt puzzled over ways of applying his steam engines, the choice of the type of drive has been an important subject to engineers. Early refrigerating machines only found wide application after they were coupled to Corliss engines. Steam engines of this type, with their excellent reliability and good economy at various speeds, were perfectly adapted to driving the large, slow moving compressors of the last century.

In the old days it was nothing unusual for an open type ammonia compressor and its engine to be operated almost continuously, day and night, for 35 or 40 years. The Hudepohl breweries, of Cincinnati, used one Corliss engine driven compressor 57 years, another 52, and two others 45 years each! When their new plant No. 2 engine room was built last year, they decided to continue with steam drive and to employ uniflow engines of the vertical type. The new boiler is capable of generating 70,000 lb per hr of steam at 250 lb pressure. It is fired by a multiple retort stoker and furnishes steam without superheat for five engines. Two of the engines are direct connected to four-cylinder ammonia compressors, a 10 by 10 and a 12 by 12. The other engines drive two 300 kw alternators and a 600 kw alternator, to take care of the entire electrical load of the brewery and have a standby always available.

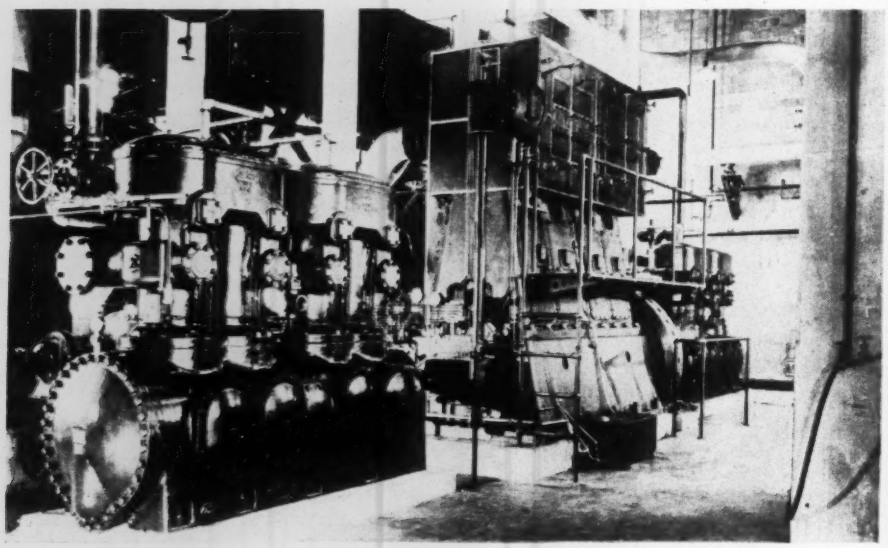
All these engines exhaust at 5 lb pressure, the exhaust steam being used for winter heating, for boiler feedwater heating, for producing all the hot water required, and for the heavy pasteurizing and bottle washer loads. Excess exhaust steam is seldom available, and deficiencies are made up with live steam, which is also used for process cooking. Direct reciprocating engine drive also gives the best possible means of adjusting the capacity of the compressors to varying loads.

The Wiedemann Brewing Co., across the river at Newport, Ky., solves this problem in a different way. Here steam is generated in a boiler of 30,000 lb per hr capacity, under 400 lb throttle pressure and 200 deg superheat. All of the steam passes through a bleeder type turbine, which drives a 1000 kw alternator at 3600 rpm. Part of the current produced by the turbogenerator is used for driving three synchronous motors, which are mounted on the shafts of the ammonia compressors. Each of these machines has two cylinders of 12 in. bore and 12 in. stroke, and is equipped with capacity controls. Each is turned at 300 rpm by its motor, which has 175 hp and 80 percent leading power factor. These motors maintain a high power factor in the plant and can be thought of as speed reducing drives of comparable efficiency with the gears and belts that would otherwise be required for driving such compressors directly with turbines. They keep enough load on the turbine at all times to permit bleeding steam at 50 lb pressure for process cooking. The turbine exhausts at 26 in. of vacuum. Steam at 5 lb pressure for all other heating requirements is obtained from steam pumps and auxiliary equipment with 50 lb pressure reducing stations to make up any deficiencies.

Nearby at Columbus, Ohio, the Franklin Brewing Co. has installed two duplicate uniflow engines, each driving a 9 by 9 reciprocating compressor through a twin disc clutch. These ammonia machines each have two cylinders and capacity controls. The system is unique in that each of the units includes a v belt driven alternator of 100 kw. Either of these two generators can carry the entire electrical load.

One of the largest refrigerating systems built in recent years with reciprocating steam engines was that installed at the Victory Ord-

One of the largest refrigerating systems built in recent years with reciprocating steam engines, at the Victory Ordnance Works, Decatur, Ill.



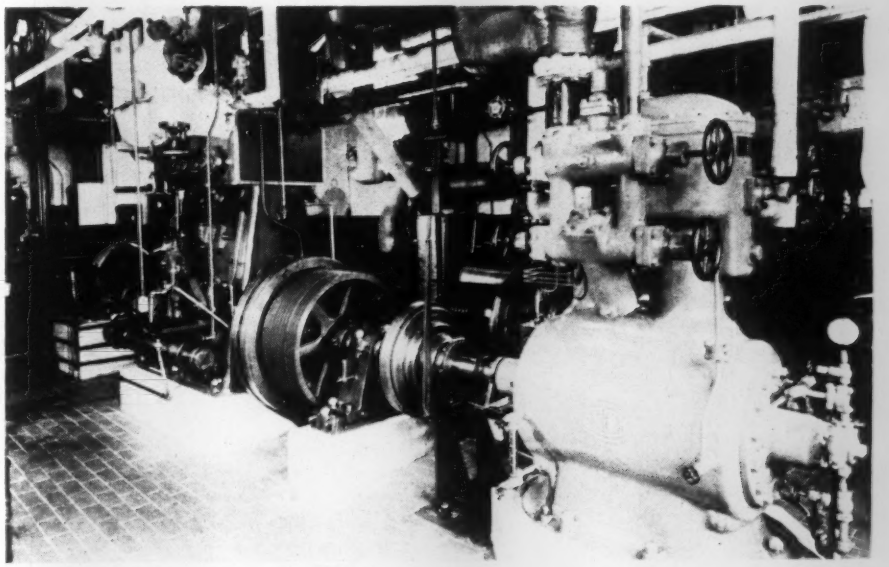
nance Works at Decatur, Ill., during the middle of the war. Vertical uniflow engines of 1200 hp are placed between a pair of four-cylinder ammonia compressors of 14 in. bore by 12 in. stroke. Each engine has four double acting cylinders, $16\frac{1}{2}$ in. by 18 in. A stout flywheel is mounted at one end. The ammonia machines are connected through flexible couplings; a pillow block is provided between the flywheel and the adjoining coupling. There are three of these double sets of big compressors.

The speed of these engines can readily be varied to meet the daily and seasonal changes in load encountered in air conditioning work. Standard speed is 300 rpm. There is a seventh large compressor, driven by a 600 hp synchronous motor, and equipped with automatic capacity control. Including a 9 by 9 machine, similarly equipped with capacity controls and synchronous motor drive, this great installation produces 4900 tons of refrigeration. The steam driven machines are connected by ammonia pipe lines to three separate banks of multipass shell and tube water coolers, mounted above the condensers and receivers. The coolers are enormous, each measuring 68 in. in diameter by 18 ft long, and having nearly 1600 tubes of $1\frac{1}{4}$ in. size. The electric motor driven machines are connected to a fourth cooler, 54 in. in diameter by 18 ft. Each of the four refrigerating systems is practically independent, and has its own set of gages, purgers, float switches, electric control valves, high and low pressure cutouts, water pressure failure switches, thermostats, etc.

Some engineers consider that an ideal arrangement for a brewery or other plant requiring process steam is to drive the refrigerating machines with reciprocating engines and to have small turbogenerators for furnishing electricity. The boilers can then be selected in sizes so that the load can be divided among three of them. One boiler would take care of the refrigerating loads in winter; any two would carry the peak loads in summer. The third is a standby available for unusual conditions. This arrangement allows one boiler to be out of service for a regular cleaning, as a part of the operating program.

Using steam pressures and superheats within the limits of ordinary steel and cast iron construction, the reciprocating engines are selected to suit the loading which will give the exhaust steam needed for process work. The two turbogenerating sets, one large enough for the entire electric load and the other suitable for night and Sunday operations, should be of a simple rugged type, not requiring expert supervision.

With this setup, the water rate will not be as good as with one large turbine, but the difference will be so little that a saving will be made over the investment required for high pressure valves and pipe lines, and higher maintenance costs.



The system at the Franklin Brewing Co., Columbus, Ohio, is unique in that each of the two units includes a v belt driven alternator of 100 kw

Installation at Dietetic Laboratories

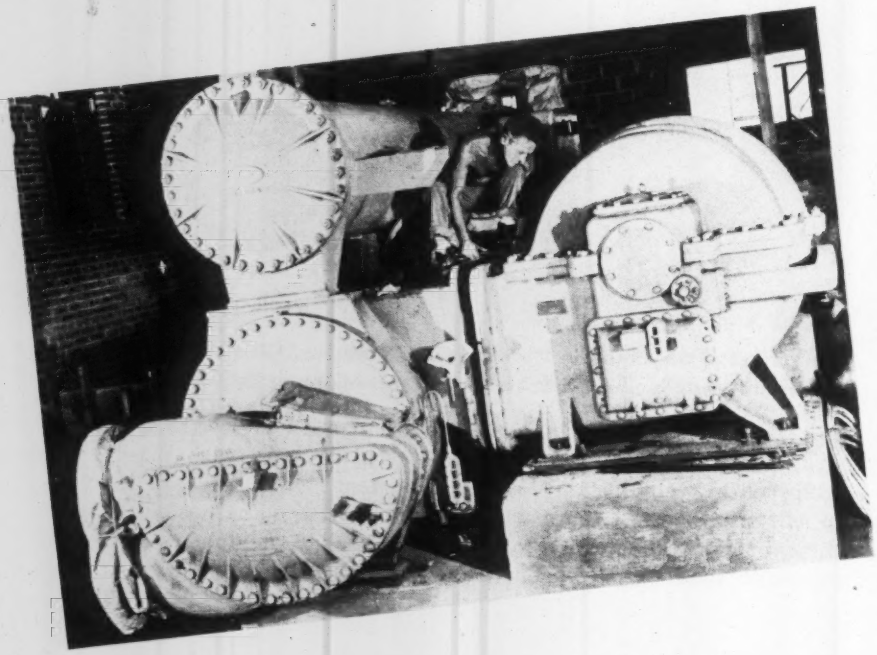
At Sturgis, Mich., the M. & R. Dietetic Laboratories, Inc., are installing a steam driven refrigerating system along similar lines. The plant is a fine new one, in which special milk products will be processed. There are two boilers producing steam at 200 lb and 500 deg temperature. These will feed a pair of counterflow engines of 10 in. bore and 12 in. stroke. These vertical engines have piston valves, and are widely used in refrigerating work. In this case the speed will be regulated between 250 and 300 rpm by manual setting of the throttle valves. Using steam pressure as low as 175 lb ga without any superheat, and with exhaust at 10 lb ga, each engine will deliver 100 hp while consuming 3640 lb per hr of steam. They are to operate normally, however, with 125 deg of superheat.

These engines are connected through flexible couplings to two-cylinder compressors of size 11 by 10, operating under 40 lb suction and 145 lb ammonia head pressure. The flywheels are on the opposite side of the engines from the couplings. The compressors are each connected to two sets of pipe coils submerged in a large tank, measuring 29 by 22 by 6 ft deep. A vertical agitator keeps cold water in circulation over each pair of coils, partitions being installed to direct the circulation and to divide the four coils into separate sets of two each. The idea is for these coils during periods of light load to freeze on their surface as much as 40 tons of ice, which will form a "bank" of refrigeration, stored against sudden demands.

The turbogenerator installed close by these machines will produce 600 kw. At some distance away there is also an $8\frac{3}{4}$ by 6 ammonia booster compressor, driven at 450 rpm by an electric motor, for handling quick freezing work at low temperatures; this machine will discharge at 40 lb into the suction of the steam driven compressor which is operating at the time.

This arrangement was selected because so much exhaust steam is needed for pasteurizing, washing, heating, and drying purposes. Even the turbines mentioned work against the 10 lb exhaust pressure.

Central Air Conditioning Serves Stores at Large Housing Project



One of the two 600 ton centrifugal refrigerating compressors being installed which, from the central power station, will furnish chilled water for air conditioning to stores, offices, and a movie in the model shopping center of the Fresh Meadows housing project. It is the first such project to recognize air conditioning as a necessity for stores and to provide it from a central point

Metering Equipment Measures Chilled Water Volume and Temperature Rise to Bill Air Conditioning Use

In the first such project of its kind, air conditioning from a central point is being furnished to the stores, professional offices, and a motion picture theater in the 16 acre shopping center of a multi-million dollar housing project in New York City.

In providing this service, the New York Life Insurance Co., the builder, has recognized air conditioning as a necessity for modern stores—just as fundamental to their operation as heat, light and water service.

More Than a Mile of 12 In. Pipe

The installation is being made at Fresh Meadows, Long Island, where, on a 170 acre tract, half an hour from the heart of New York, a completely integrated community for 10,000 persons is being built. It includes 3000 apartments, playgrounds, landscaped lawns, garages, model shopping district, and a new public school.

To furnish air conditioning for the shopping center, chilled water piped through more than a mile of 12 in. pipe under 100 lb head pressure will be delivered to the individual stores. To provide this service, two 600 ton electric driven centrifugal compressors have been installed in the central power station.

The compressors in the central plant will be supplied with condenser water from two specially bored wells. The used water from the condensers will be returned through two diffusion wells to the same underground strata from which it is pumped.

Air ducts, fans, and all necessary adjuncts for an air conditioning system are being installed in the stores as they are built.

Community Planned for "Living"

In emphasizing the importance of air conditioning in a multi-million dollar housing project of this type, Vice President Otto L. Nelson, Jr., of New York Life, told Cloud Wampler, president of Carrier Corp.:

"When completed, Fresh Meadows will be the home of some 10,000 people. In planning this large development, our objective has been much broader than merely to provide 'housing'; rather it has been to plan an attractive, modern community for desirable 'living'. For this reason, we have given a great deal of thought to such things as air and light, landscaped areas, play space for children, availability of schools and recreational facilities, and many other items which are important in everyday family life.

"High on this list, of course, is shopping convenience and comfort. The main shopping center will be one of Fresh Meadows' outstanding features, and in our plans we have naturally given careful consideration to the large scale use of air conditioning."

In the shopping center will be a 2100 seat motion picture theater

UNIVERSITY OF MICHIGAN LIBRARIES

and a branch of Bloomingdale's, large New York department store. The store will occupy 105,000 sq ft of floor space distributed over three selling floors. All of the store occupants of the shopping center have been carefully selected to provide, in one 16 acre area, practically every commercial service required by the ordinary family. There will be professional offices for doctors and dentists, all provided with facilities for air conditioning. Nearby will be parking areas accommodating 1000 cars.

The outstanding features of this unusual central station air conditioning installation are described by H. E. Meeker, of the firm of Meyer, Strong & Jones, consulting engineers, New York, which designed the system, as follows:

"One of the principal advantages of the central refrigeration plant planned for this development is the economy it will effect in initial cost and in annual maintenance and operating cost. In addition, it is a much more flexible scheme in that no provision need be made in the design of individual buildings for refrigeration equipment, cooling towers, or other such items. Furthermore, subsequent changes in tenancy can be taken care of easily, with relatively slight structural changes to the building. Another important advantage of the central system is the flexibility provided for future extension of air conditioning facilities to future tenants.

Btu's for Cooling Are Metered

"An unusual feature, applying to the larger air conditioning systems of the project, is the metering equipment provided for measuring the chilled water. These meters measure not only the volume of the chilled water used but also take into account the temperature rise of the chilled water through the air conditioning equipment. These two factors are integrated and totalized in terms of million Btu units. It is believed that the application of such meters in connection with the sale of refrigeration for air conditioning is unique with this development."

Architects for the project are Voorhees, Walker, Foley & Smith, of New York, with Meyer, Strong & Jones as consulting engineers. The general contractor is the George A. Fuller Co. J. L. Murphy, Inc., was awarded the heating and air conditioning contract.

Supervising the project for New York Life are G. Harmon Gurney, chief architect, and Richard T. Geoghegan, construction engineer, of the housing department.

New York Life hopes the entire project can be completed and entirely occupied before the summer of 1949.

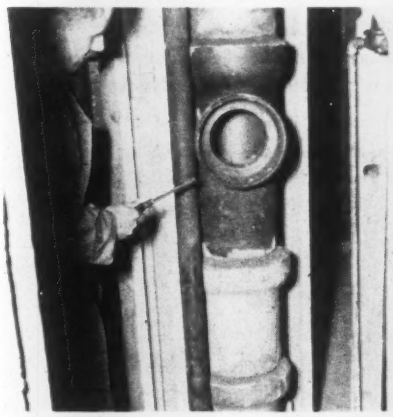
Venting Heater Rooms in Apartment Project

Vitrified clay pipe duct starts at ground floor. Beneath duct is foundation to prevent settling

In the design of a 324 apartment development for South Euclid, O., it was decided to use individual gas fired hot water heaters in each of the 324 apartments. Necessarily, each unit requires a vent for carrying off the gases of combustion.

To exhaust fumes, simple vertical duct systems were installed. The apartments were designed in a manner that allowed placing these units in 3 ft, 6 in. by 4 ft, 0 in. spaces. These rooms open directly into the main public corridors. This facilitates maintenance without disturbing the occupants.

Each building is three stories in height with identical suite arrangements on each floor. Three heating units, one on each floor, were placed in a vertical line. It was a simple matter then to connect all three boilers into a single flue duct. For the 18 apartments in each building unit, there are six ducts leading from the first floor through the roof.



Gas vent fits snugly in corner of recess

A seventh duct was installed to carry off the exhaust from the clothes dryers and hot water heaters in the laundries.

The duct material is 8 in. diameter vitrified clay pipe, in lengths of 2 ft which gives flexibility. Eight-inch pipe is sufficient for the exhausts of three 5 in. boiler outlets.

Prior to installing each duct, a separate foundation for each duct stack was built. This was cast of concrete 12 in. thick and about 18 in. below the first floor level. The first section of clay pipe was anchored to the foundation. A clay tee was installed to receive the exhaust connection at each floor.

The heater rooms are separately ventilated. Individual ducts connect the three rooms in vertical alignment and terminate on the roof. This eliminates any possibility of overheating the heater space. —MAXWELL H. WHITE, architect, Cleveland.

Duct extends through roof. Vitrified clay vent cap will go over duct, protect opening from rain

The Engineers and the Doctors Have Many Interests in Common

V. L. SHERMAN—teacher, writer, editor, member of the American Society of Heating and Ventilating Engineers, past-president of its Illinois chapter, and (in general) a "man about the industry"—gives some personal recollections of the growing collaboration by the medical and the engineering professions

AIR CONDITIONING might possibly interest one doctor in a thousand." That was the reply, about 20 years ago, of Dr. W. A. Evans, then editor of the "how to keep well" column in the Chicago Tribune. As for himself, he was much interested in air conditioning and well qualified to discuss it beyond my experience. As former health commissioner for the city of Chicago, his studies of ventilation and health were well known.

The engineers of the time were working energetically, led by the ASHVE, then in its 34th year. Dr. Willis Carrier's "Handbook" had been published in 1914. The ASHVE research staff had been established in 1919, and the first publication of the ASHVE Guide came in 1922. While air conditioning problems were well handled then by relatively few engineers the amount of pertinent data they had accumulated was invaluable. The public had little acquaintance with air conditioning. Possibly this was because the refrigerants of the day were mostly ammonia, carbon dioxide, and ice. These refrigerants were fit for industrial use, but hardly for small air conditioning units. News writers found little human interest in the subject, and found it tough going as well.

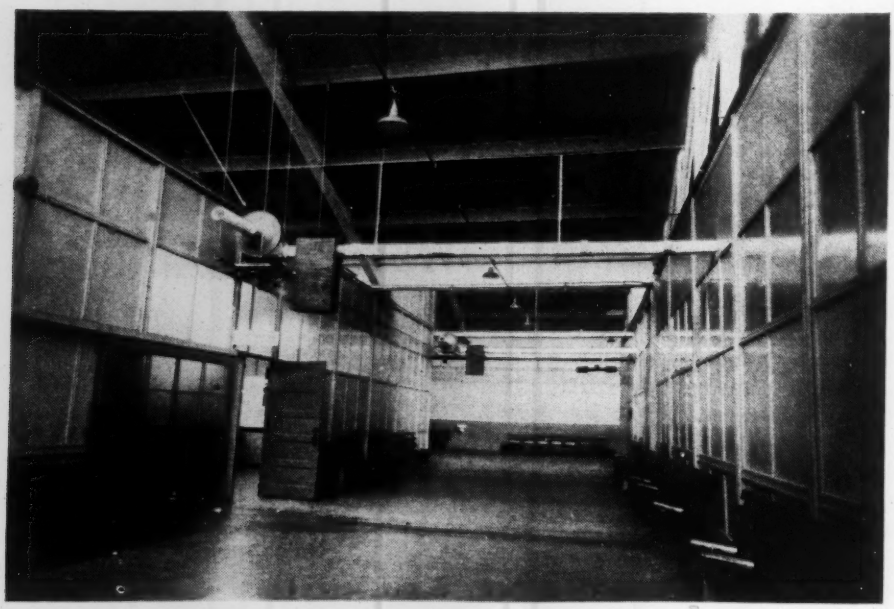
Fifteen years ago, the Century of Progress opened in Chicago. The exhibits of air conditioning equipment and house design attracted the public. For publicity, the exhibitors had Malcolm McDowell, science editor of the Chicago Daily News, to tell their stories in layman's language. (Mr. McDowell had an exasperating trick, always a preliminary to our talks. He would reach down into a deep desk drawer and heave up a huge stack of scientific literature and releases with the demand that they "be translated into readable English").

During the winter at the exposition, a new type of house was being erected—one with much glass exposure to the south. It was discovered that the workmen in the house shed their heavy clothes when the sun hit the floor. Solar heat interested the engineers and some of the doctors speculated on winter sunlight through quartz glass in connection with vitamin D. Deep eaves shaded the higher summer sun but admitted the lower winter sun.

An increasing number of physicians were interested in winter air humidification and summer air dehumidification. Air conditioning was gaining the interest of the doctors, especially those who had for years been working on the problems of ventilation.

About a dozen years ago, when room conditioning units were making their bid, my family doctor went with me to visit E. P. Heckel in regard to a room conditioner. The doctor suffered from hay fever, which generally culminated in asthma. The attacks weakened him. To make it worse, the late summer storm that brewed the asthma dealt the same dose to most of his asthmatic patients whom he had to attend. To make it brief, the doctor got his room conditioner, his sleep.

An atmosphere containing as little as 0.0017 gr of triethylene glycol per cu ft of air has been found effective for killing practically all airborne germs, according to Burgess Jennings in an article on air sterilization for the American People's Encyclopedia. This shows an overhead duct unit for distributing glycol vapor in a classroom building



UNIVERSITY OF MICHIGAN LIBRARIES

regained his strength, and made his daily rounds. His one regret was that his alibi for his September fishing trip was gone. How many of his patients bought room conditioners isn't known, but there are a number in the village.

About that time, or a little before, it was my good fortune to have two doctors from the University of Illinois college of medicine give lectures during the courses I was teaching in air conditioning. My notion was that the more the engineering students could learn of physiological reactions of the body to atmospheric conditions the more surefooted they would be. Dr. William F. Petersen discussed the effects of the weather in all its phases on people of different types and of the different effects on men and women. Dr. Owen Lay, recently retired as regional forecaster of weather for the Chicago area, assisted Dr. Petersen in his research. But Dr. Lay scorned artificial air conditioning when he retired. Last year he built his home at Skyland, in North Carolina.

The Common Cold and Its Treatment

Dr. Lloyd Arnold discussed the common cold and its treatment. He also went into the case of high temperatures in relation to the internal organs, particularly the digestive tract. He showed how excessive heat led to the shifting of blood from within to the body surface to increase the work of the skin as a heat exchanger. The insufficiency of blood in the digestive tract lowered its bacteria killing power. "Summer complaint" it was called in my early days, usually from becoming overheated after a fruity meal. It used to be vengefully hot in the Illinois River valley, but the boys never hurried and went swimming twice a day in the river or canal. Loafing was the common pursuit. Possibly more loafing or a compensating environment of conditioned air might head off some of the cases of polio, for it is said that "the lazy child doesn't get polio."

Twenty years ago Dr. Evans had said that possibly one doctor in a thousand might be interested in air conditioning. Fifteen years ago the doctors and their patients found hope for relief in hot summer weather. Now, with the research doctors lending a hand as members and non-members, the ASHVE Guide contains nearly 20 pages of Physiological Principles and 14 pages on Air Conditioning in the Prevention and Treatment of Disease. There are 14 ASHVE research report references for the first and two for the second in a total of 53 references listed.

The benefits of the studies by the engineers and doctors in their work in World War II are appearing, and today the graduate students and their professors in what used to seem isolated science departments are telling the engineers of the importance of relative humidity in dealing with airborne disease.

Lethal Effect of Relative Humidity

From the Journal of Experimental Medicine, for February 1, 1948, for example, comes a paper on The Lethal Effect of Relative Humidity on Airborne Bacteria, by Edward W. Dunklin and Theodore T. Puck of the University of Chicago's departments of medicine and biochemistry. In this investigation, 50 percent relative humidity seems to be the maximum state of lethality at a temperature of about 72 F. And that isn't all. The last sentence of the first paragraph modestly states that "the marked influence of water vapor on the action of aerial germicides also makes desirable more careful study of its effects on microorganisms."

A somewhat parallel case was the work done by Burgess Jennings, head of the department of mechanical engineering at Northwestern University, and Doctor Edward Bigg of the school of medicine. They developed a process of glycol vapor sterilization which was applied at the Great Lakes naval training station. Most of my readers are already familiar with this work. For myself the Jennings-Bigg report is satisfying, but the research doctors, working by themselves, clothe their results in a vocabulary known only to themselves.

The engineers had better draw in more of the medical profession and work to rationalize the vocabularies. Possibly a metric system psychrometric chart would prove an inducement.

ATOMIC PLANTS MAY MAKE MORE FUEL THAN THEY USE

Future atomic power plants may solve the age-old problem of eating one's cake and having it, too, according to Dr. C. G. Suits, vice president and director of research for the General Electric Co.

Explaining an exhibit which the Atomic Energy Commission financed and G. E. prepared for Man and the Atom, a section of New York's golden jubilee exposition, Dr. Suits told how atomic plants probably will be able to create more nuclear fuel than they use while they are generating power.

The atomic reactor, or "pile", yields heat energy as nuclei of atoms of uranium 235 are split, and at the same time nuclei of uranium 238, the more common kind, are transmuted to plutonium. The latter element is also capable of the energy-yielding process of fission, and can be used as a nuclear fuel itself. However, he added, the process does not continue indefinitely, for a reactor using only plutonium would not turn out additional fissionable material. More uranium must be added.

Methods of using nuclear fuel most efficiently, so that the maximum yield both of power and new fuel may be obtained, are now engaging the attention of scientists at the Knolls atomic power laboratory, at Schenectady, said Dr. Suits. This laboratory is operated for the Atomic Energy Commission.

Dr. Suits said that vast numbers of challenging technical and economic problems confront the scientists, engineers, and technicians who are working in this field.

"However," he added, "enough problems should be solved at the Knolls laboratory in a few years to make electrical power experimentally—if not economically. Will substantial amounts of useful atomic power be available to us in 1965? —1975?—2000? The answer will depend upon the future of technological, economic, political and international developments."

Your January issue will include a complete and up-to-date Directory Section of Heating, Piping, and Air Conditioning Equipment for Industrial, Commercial, Institutional, and Public Buildings.

UNIVERSITY OF MICHIGAN LIBRARIES

SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

Scotch Marine Boilers Have Many Uses on Land and Sea

Fuel oil, gas, and spreader coal stokers "revitalized" the Scotch boiler industry, says Mr. Lewis in this practical discussion of some of the characteristics of this well-known type. Meticulous conditioning of the feedwater is most important, he states . . . . .

SCOTCH MARINE boilers are an ancient type that served well on shipboard during the early ages of steam navigation. Since these boilers are relatively free of flat stayed surfaces, they are excellent pressure vessels. The shells are cylindrical and the flat ends easily can be supported by the tensile effect of the expanded-in horizontal tubes, supplemented by internal through-rods and diagonal braces.

A characteristic of the boiler requires that the products of combustion flowing out from the water-jacketed furnace must rise at the back end in a gastight compartment so as to pass forward through the tubes to the breeching at the front end. This compartment can become exceedingly hot. In most marine Scotch boilers, this compartment is called a wet back, since it is necessarily composed of approximately flat surfaces that have internal stay bolts and are in circulatory connection with the water of the boiler.

Scotch marine boilers when used on land generally have dry backs. The rear compartments in such boilers are not water jacketed, but may be lined with heat reflecting masonry.

The firebox or combustion chamber in a Scotch boiler is a horizontal tube strong enough to resist the external pressure and also strong enough to help the conventional fire tubes above it in their part-time job of holding the boiler ends from bulging outward.

In large Scotch boilers there may be several of these combustion chamber tubes. The outer shell of a Scotch boiler is under tension, due to the pressure of the steam and water, while the combustion chamber tube, like any boiler tube, is under compression as far as concerns its cross section, but must be under tension as concerns its longitudinal section, due to its secondary job of preventing bulging outward of the end plates of the pressure vessel.

The combustion tube necessarily is of considerably smaller diameter than the diameter of the boiler shell and must endure particularly arduous expansion and contraction strains, since the coal fired end will be very hot on top and relatively cool at the bottom where air for combustion on its way in to the fire competes with ash on its way out.

Many marine engineers, graduated from sea duty to land practice, have tended to use Scotch boilers for heating plants in buildings. The type is flexible; that is, the diameter of the shell can be reduced from the shipboard style—which generally is large, with short tubes—to a relatively long, slim, boiler that can be placed in a shallow basement. The Scotch boiler holds a lot of water and gives an impression of considerable reserve capacity against sudden demand. There is always a large water surface to permit desirable release of the steam with minimum turmoil.

It is doubtful whether any good

marine engineer would install on shipboard a boiler 20 ft long and 6 ft in diameter, with an interior corrugated furnace limited to, say, 34 in. in diameter. We find such slim boilers frequently in shallow basements. The shipboard boiler would be more likely to have a 20 ft diameter and perhaps four 48 in. furnaces only 12 ft or so long. The large diameter shell requires exceedingly heavy construction when high pressure steam is to be generated. A boiler 20 ft in diameter for 200 psi working pressure, for example, would have a shell the metal of which would be practically 3 in. thick.

It is no fun at all to maintain acceptable combustion and to prevent objectionable smoke from a fire in one end of a furnace that is only 34 in. in diameter. This furnace must contain enough room for hoeing out ash and for the entry and distribution of air, must have grate supports and grates, must have a lot of burning fuel, must still have enough room for the chemical reaction (which is combustion) at a highly elevated temperature, and when manually fired must permit the fireman somehow to introduce enough coal to keep the long narrow grate covered with a reasonably uniform thickness of fuel.

This is well-nigh a physically impossible manual task, and so we find one solution by building out in front of the boiler a refractory lined masonry structure, containing a relatively wide combustion chamber, grates, and ashpit. Usually this structure is encased in sheet steel and is harnessed with structural steel beams and angles. Sometimes heat-absorbing water tubes are built into it and hot water from the boiler is pumped around through these tubes. The exterior apparatus is called a Dutch oven, due to its resemblance to an outdoor, oldtime, bread-baking oven.

When fuel oil became available, the Scotch boiler returned to popularity. With properly warmed and atomized oil it is possible to maintain smokeless and efficient combustion within the tubular furnace, and no Dutch oven is necessary. This combination of Scotch furnace and oil, as well as a similar one using gas fuel, has revitalized the Scotch boiler industry. After all, the boiler—while sluggish as to internal water circulation, and close and tight as to facilities for removing mud and scale—is a splendid heat absorber, and is a strong, safe pressure vessel.

There have been devised recently several types of very compact forced draft underfeed and overfeed mechanical spreader coal stokers that will do a far better job in the small diameter Scotch furnace than can possibly be done by manpower alone. Absence of flat-stayed heat absorbing surfaces in the Scotch boiler makes for confidence in its troublefree maintenance when operated at comparatively high pressure. Scotch boilers rarely explode, and have the reputation of enduring water that is badly contaminated.

It must be remembered, however, that the modern oil burning, compact, Scotch type boiler often is made to develop a horsepower with as little as 5 sq ft of heat absorbing surface. This high rating requires the most meticulous conditioning of the feedwater. No one familiar with the difficulty in clearing mud and other debris from the areas under the furnace between it and the shell of a Scotch boiler will countenance contaminated feedwater.

AIR CONDITIONED CRANE CABS AID OPERATION

Recent developments in industrial air conditioning have made possible the reduction to 80 or 85 F in temperatures of crane cabs exposed to large quantities of radiant heat, according to R. D. Darrah, of the Dravo Corp., in a talk on air conditioning of crane cabs, before the Iron and Steel Engineers convention.

According to Mr. Darrah, mechanical refrigeration also provides the only successful means of sufficiently reducing concentrations of carbon monoxide gas in crane cabs. With air conditioning, this concentration can be reduced to 70 or 80 percent less than the concentration in the ambient air of the plant.

Self-contained air conditioning units using air for condensing purposes have proved most satisfactory. For cutting costs, Mr. Darrah recommends complete insulation of the cab before air conditioning, and the installation of a heat shield below the floor of cabs operated around soaking pits and other hot metal cranes.

STEELMAKING "DREAM" A REALITY

The "dream of inventors for a century" that steel might be made from the liquid phase to semi-finished shape in one simple, relatively inexpensive machine has become a reality through a joint development of the Republic Steel Corp. and the Babcock & Wilcox Tube Co., it was revealed recently.

The results demonstrated at Beaver Falls, Pa., in continuous casting of semi-finished steel, were said to open up possibilities of utmost importance to the entire steel industry through increasing productivity and decentralizing production by simplification of apparatus and increasing the final yield of steel from the original melt. The new method and apparatus are considered a timely response to great economic pressure to serve areas locally. Interest in the possibilities of continuously cast semi-finished steel is enhanced by current uneasiness over the high break-even points and the doubled and tripled cost of new productive facilities.

The greatest single advantage of this process, according to the announcement, is that it removes from the conventional process of steelmaking the most massive and expensive parts of such plants.

FUEL OIL STANDARD IS REVISED

The National Bureau of Standards has announced a revision of Fuel Oils Commercial Standard CS12-40, the revision to be identified as Commercial Standard CS12-48.

The revision was developed by a technical committee of the American Society for Testing Materials and endorsed by the standing committee for the commercial standard. The purpose is to bring the standard into line with current refinery practice and burner construction.

The revision was circulated on May 10, 1948, by the bureau to producers, distributors, testing laboratories, and users for written acceptance. Since that time acceptances have been received representing a satisfactory majority of production.

Printed copies will be available as soon as practicable. Until that time, mimeographed copies may be obtained from the Commodity Standards Div., National Bureau of Standards, Washington 25, D. C.

UNIVERSITY OF MICHIGAN LIBRARIES

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Those published are paid for at regular rates. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

Asks What Are Today's Trends in Heating & Air Conditioning

You are invited to answer the following question from "R.H.C." Suitable comment on this matter will be published, and paid for at regular rates (with additional payment for sketches). Address The Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"I have been asked to make a talk before a luncheon meeting of businessmen on significant trends in heating, ventilation, and air conditioning. I of course have some ideas on the subject but would appreciate any comment from other readers so I won't overlook anything that should be brought out. I don't believe I should discuss specific commercially available equipment in a talk of this kind, but rather the overall, general development and the newer methods of application."—R.H.C.

Room Air Temperatures for Ice Skating Rinks

QUESTION OF THE MONTH published in the August HPAC came from a consulting engineer. "We have been endeavoring to find data relative to room temperatures that exist in a room containing an ice skating rink," he asked. "Any information along these lines will be appreciated."

Some figures on the matter have been obtained from several sources:

M. C. Turpin, secretary of the American Society of Refrigerating Engineers, New York, refers to this statement from the ASRE's Application Data Section No. 9, on the subject of Refrigeration for Ice Skating Rinks. "Enclosed rinks operate satisfactorily with an inside temperature of up to 60 F with ice at just below the freezing point. One system for control of ice surface calls for control of the room temperature to 40 to 60 F depending on the number of skaters. The ice temperature is held around 20 F."

Herman Vetter, consulting engineer, Los Angeles, advises that the temperature of a room containing an ice skating floor will depend upon many factors, such as proximity to the ice surface, outside atmospheric conditions, etc. However, he says that in most cases the room temperature will usually be about 50 to 60 F dry bulb with a relative humidity of 80 to 85 percent. The temperatures and humidities existing in a room containing an ice skating rink do not lie within the comfort zone as determined by the American Society of Heating and Ventilating Engineers, he points out, and therefore heating should be provided for the comfort of spectators.

Temperatures in a Large Arena

An executive of a manufacturer of refrigeration equipment sends information from a well-known designer of ice skating rinks to the effect that in large rinks the temperature of the air above the seats averages about 65 F. At a distance of 36 in. above the ice floor, it is close to 50 F. The handling of an arena

therefore involves a certain amount of heating if spectators are to be kept comfortable.

The same executive also furnishes information from another source, the former chief engineer of a large arena. This engineer advises that 65 F in the seating area is a good temperature for hockey games and ice shows, and that on this basis the temperature will be about 50 F 3 ft above the ice. Of course, during a hockey game or an ice show the air above the ice is pretty well agitated which lowers the temperature as much as 5 or 6 deg at this point. He states that they never had any complaint about the temperature in the arena during hockey games and ice shows, but that he found that after the arena was filled with people it did not take long for the temperature to rise another 5 or 6 deg in the seating area, in spite of the fact that the heat would be turned off and that the outdoor temperature might be pretty low.

For boxing matches, basketball games, wrestling matches, etc., he found it necessary to maintain a temperature of 70 F in the seating area.

Another firm (that has done a large amount of skating rink work in Canada) says that the temperature in the seating arena should be not higher than 60 or 65 deg in places as warm as Toronto or warmer. However, farther north they find people come to witness events at skating rinks so warmly clothed that 50 or 55 deg is more suitable. The McIntyre rink in Schumacher, which is 500 miles north of Toronto, received complaints that the seating arena was too warm until the the temperature there was reduced to 50. The outside temperature at the time was about 20 above zero.

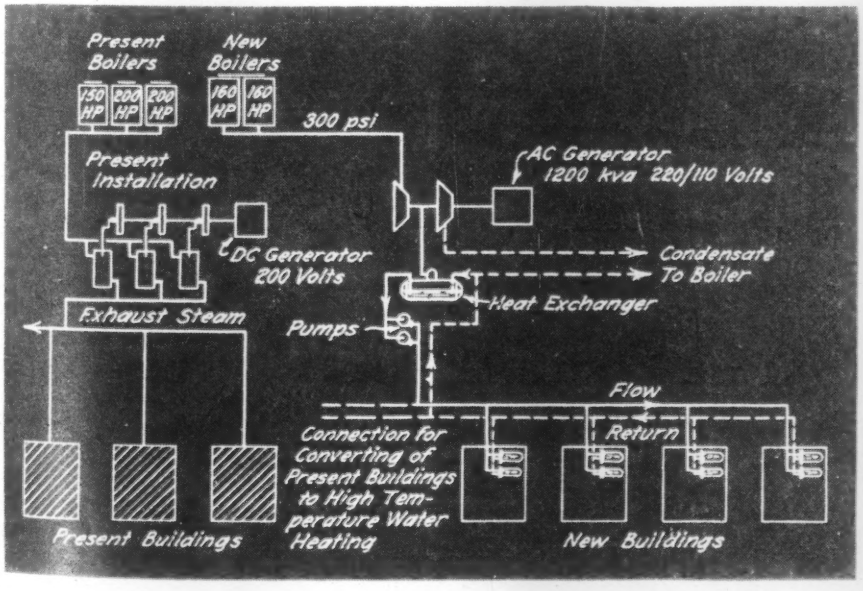
Supplying Heat and Power to College Building Group

IN THE JULY Question of the Month department, the chief engineer of a college asked for suggestions on how best to supply steam and electricity to the present buildings and the proposed new buildings. Comments on the matter from readers were published in September, and this month the chief engineer of a firm specializing in liquid heating at high temperatures for space and process services submits the following suggestions:

The periods of steam and power consumption in a college do not coincide too well and the overall power consumption is not large. In most cases it is, therefore, preferable to purchase electric power, if available. The cost of operation and the investment for a plant generating at the peak less than 1000 kw cannot usually compete with the prices for power offered by large utilities.

I have, therefore, worked out two solutions, one under the assumption that power cannot be purchased, and another assuming that power is supplied from the outside.

Fig. 1—"P.L.G." suggests the use of high temperature hot water, with heat exchangers in the buildings for domestic hot water, low pressure steam, or low temperature water



QUESTION OF THE MONTH

High Temperature Water Heating

For the efficient operation of heat and power distribution within the college area, it is most important to reduce the losses of transmission to a minimum and to use a method of heat distribution which permits the close adjustment of heat supply to the heat demand. For obtaining low investment cost, it is essential to use a heat distribution level corresponding to a steam pressure of 80-85 psi.

Efficient and economical heat distribution is possible using fluid heat distribution. I would, therefore, propose the use of such heat distribution.

The present boilers, although old, are operating at about 250 percent of rated capacity. If they are capable of raising so much steam it does not appear desirable to scrap them yet.

For the additional load (71,888 lb per hr—46,600 lb per hr = 25,200 lb per hr) I suggest installation of two 160-200 hp boilers, or one 300-400 hp boiler. Later the old boilers would be replaced with one 400 hp and one 160 hp boiler. The boiler pressure should be selected at 300 psi.

For the power production I propose the installation of a 1200 kva, 220 volt, a-c turbo-generator.

In the power distribution, a-c current should be selected for the following reasons. Conduits and buses are cheaper for a-c; standby power is only obtainable for a-c; a distribution voltage of 208/110 volts a-c would furnish 110 volt current for the lighting without transformer installation. The present 200 volt d-c

QUESTION OF THE MONTH

installation could be converted to a-c. If it is a split phase installation the conversion may not be too hard. If, however, 220 volt light bulbs are at present in use, this practice may be continued in order to avoid too great expense for new cables.

It would be advisable to install a bleeding turbine with an admission pressure of 300 psi and 750-850 deg superheat. I suggest setting the bleeding point at 80 psi. The combination with the old plant is shown in Fig. 1. It is assumed that the old engines are kept in operation as long as the old boilers are used; later the turbine will take over their output.

The steam leaving the bleeding point of the turbine with 80 psi is converted in a direct contact heat exchanger into high temperature water of about 320 F. The high temperature water is circulated from there on in an absolutely closed circuit to all the buildings, and the heat contained in the high temperature water is used to raise domestic hot water, low pressure steam, or low temperature water. The high temperature water returns cooled to the heat exchanger, the circuit being completely closed and always under pump pressure and the steam pressure of the heat exchanger. In the individual buildings, as shown in Fig. 1, small heat exchangers are installed which take care of the heat conversion.

This method has been successfully applied for heat distribution in a large number of colleges and hospitals in Europe and in England. The famous Polytechnik in Zurich, Switzerland, and many other large institutions transfer heat from a central plant to the individual buildings using this method.

If it is assumed that it is possible to purchase outside power at reasonable rates, I suggest more or less the same installation (as shown in Fig. 2) but using an operation pressure of 175 psi for the high temperature water distribution. The raising of the distribution pressure and temperature will still more accentuate the advantages of the system. A larger temperature drop can be used in the circulation of high temperature water and still smaller pipe lines can, therefore, be applied.—P. L. G.

GAS CALORIMETER TABLES REVISED

A new revision of Gas Calorimeter Tables has been announced by the National Bureau of Standards. This publication (NBS Circular C464, for sale by the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 15 cents) includes instructions for use of the water flow calorimeter in measuring the heating value of fuel gases, as well as tables required for the necessary calculations.

In the circular there has been some change in notation and in the method of deriving equations for humidity corrections. Some minor errors in the tables of an earlier circular have been corrected.

CLEANING STOKER FAN PUTS PLANT IN SHAPE

"To illustrate just how important the combustion check of a stoker fired heating plant can be, I would like to relate a personal experience. This happened in the plant in which I was working at the time and the heating system was under my supervision. We had several boilers—one of which was used to heat the offices only. The boiler and stoker were both loaded to the hilt so that in ordinary weather we could get by on an inexpensive local coal but in severe weather we had to change to coal with higher heat value to carry the load.

"One morning the temperature was well below zero and in spite of the best efforts of the fireman he could not raise steam on that boiler even with the good coal. He called me out and so far as I could see everything looked normal. There was a swell fire, the flues had just been cleaned, stack temperature was about normal and CO_2 was about 13 percent. Finally in desperation I ran a complete flue gas analysis and found we had better than 1 percent CO. The fan which was ordinarily ample for the job was wide open but we were still not getting enough air. With some idea of trying to put in a higher capacity fan, I had the regular fan taken out but when I saw it I realized what that trouble was. The fan blades (which were the usual forward curved type) were filled with an accumulation of dust until the forward surface of the blade was nearly flat. I knew that would interfere with air delivery so we cleaned the fan and put it back on. We had to cut down on the air adjustment after that because we had excess air but within 20 min. the steam was up and the stoker shut off on pressure. We had about the same CO_2 as before, a slightly higher stack temperature, but no CO."

—from a talk on stoker operation by John Roland, heating engineer, Conco Engineering Works, Mendota, Ill., at a fuel conference at Purdue University.

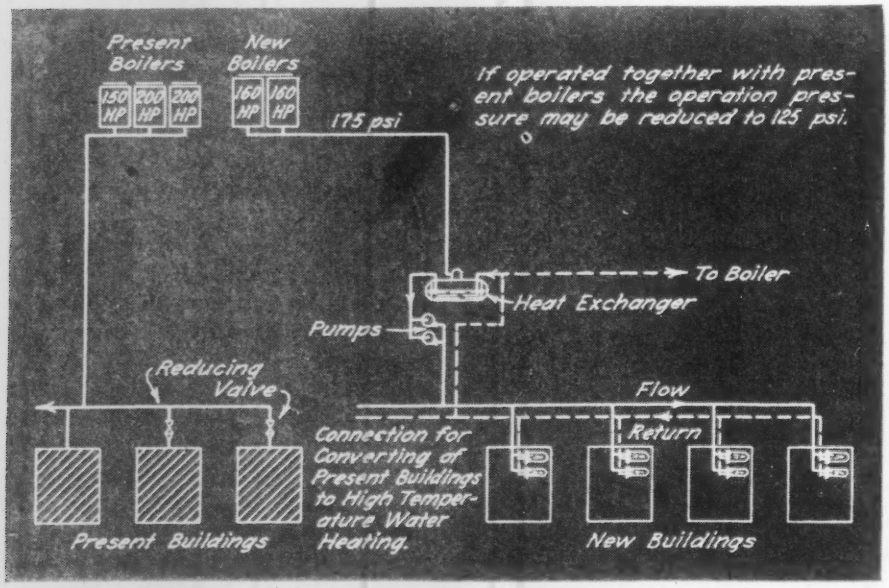


Fig. 2—If outside power is purchased, "P.L.G." recommends a similar scheme to that shown in Fig. 1, but using an operation pressure of 175 psi for the high temperature hot water

UNIVERSITY OF MICHIGAN LIBRARIES

"Open for Discussion"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago

Reducing Scale on Evaporative Condensers

THERE IS INDEED a great deal of discussion and controversy regarding the use of desuperheating coils and other means for reducing scale formation on lower coils of evaporative condensers. I hereby offer an "armchair analysis" of this problem in the hope that some much needed light might be shed on the subject.

A temperature gradient exists in the coils of an evaporative condenser from high at the top row where the superheated gas enters to low at the bottom row where the liquid leaves. Condensation takes place in the intermediate tubes when the temperature of the superheated gas is reduced to the condensing temperature at that particular pressure. Latent heat is of course given off at this lower and constant temperature. Then, as the liquid travels on down, it loses heat until it leaves the condenser.

Since the upper coils are warmer, evaporation here is greatest with the result that the mineral concentration in the unevaporated water is greater. The increased mineral concentration tends toward precipitation but the increased water temperature tends toward greater solubility so that in effect the result is little or no precipitation on the hot upper coils.

As this warm water falls through the lower coils, the mineral concentration increases and the temperature of the coils decreases. Somewhere along here the solubility products of the mineral are exceeded at the lower temperatures to the point of precipitation resulting in scale formation.

The use of desuperheating coils will lower the degree of superheat of entering gas and accordingly decrease the mineral concentration of the spray water due to high evaporation rates at the top coils. The result will be a lower rate of scale formation on lower coils, in addition to increased condenser efficiency.

However, it seems to me that either with or without desuperheating coils scale formation can be considerably reduced in condensers by introducing additional spray water on the intermediate and lower coils for maintaining a low mineral concentration in cooling water to prevent precipitation.—O. GERMANY, Airtemp engineer, export div., Chrysler Corp.

SELECTING PUMPS FOR HOT WATER JOBS

REFERRING TO THE article on Simplified Pipe Sizing for Hot Water Heating Systems, in the September HPAC:

We believe that the procedure given in this article can result in the use of a pump using a higher horsepower motor, which would make it more costly to purchase as well as to operate. With the procedure it is necessary first to size all of the piping and then determine the pump head by adding up the friction through all of the piping connections and equipment on the job. This fixes the pump head required. Next, a pump is selected that develops a head as close as possible to the requirements and the gallons per minute needed for the job. Since pumps are designed to meet a definite curve, a larger pump could be required in order to develop the head demanded by this procedure.

With the pipe sizing method used by ourselves and that outlined in the ASHVE Guide, we first determine the gallons per minute re-

"OPEN FOR DISCUSSION"

quired to heat the project and next select a pump circulating that amount of water. From the pump curve we can determine the head developed at this gpm output. The system is then sized so that the friction through the piping and system is equivalent to the pump head.—LAWRENCE J. SMITH, director of research, Bell & Gossett Co.

LIKED RADIANT HEATING ARTICLE

CONGRATULATIONS to T. Napier Adlam on his article on radiant heating in the June issue of Heating, Piping & Air Conditioning. Indeed, he has brought to light many pitfalls that the inexperienced builder or engineer is likely to encounter. He also answered most of the questions that are asked by persons unfamiliar with radiant heating, and questions that are not answered in the technical books.

I not only enjoyed the article, but also gained a great deal of knowledge from reading it.—C. H. KEESLING, plant engineer, Food Machinery Corp.

PROTECTING MATERIALS BY DEHUMIDIFYING

I HAVE THE following comments to offer on John Everetts, Jr.'s, discussion of my article, Dehumidification Protects Materials from Deterioration, which discussion was published in the September HPAC:

I agree with Mr. Everetts that storage under average relative humidity conditions of 50 percent is, for practical purposes, safe storage. It is rather clearly indicated, however, that the lower the moisture content of the atmosphere, the less tendency there is toward deterioration. For this reason, where it is economically feasible to maintain relative humidities in the order of 30 percent, I believe it desirable to do so. At the same time, I can see little justification for adoption of extreme measures to lower the relative humidity below 50 percent.

I entirely agree with his comments on problems of control. Our problem is one of maintaining acceptably uniform conditions in groups of compartments so isolated that diffusion and convection cannot do the job if a single control point is used. Averaging control from multiple points appears to be necessary to its solution. The general problem is not of this nature and a single control point seems to be adequate for most applications.

Mr. Everetts raises a point most difficult of further comment. While I should like to see the inactivation-reactivation cycle completed in the premises of completion of technical information, I deeply hope that we shall not be forced into a practical large scale demonstration of the efficacy of controlled humidity in preserving interiors of combatant ships.—GEORGE C. WELLS, commander, USN, bureau of ships, Navy Dept.

VENTILATION NEEDED IN USE OF CARBON TET

I HAVE READ with some interest the article concerning cleaning ducts in the July issue.

I noted with some alarm the fact that carbon tetrachloride was recommended for cleaning ventilating equipment although no precautions were given in the original article (although they were published in subsequent issues) concerning the control of this solvent insofar as the person exposed to its vapors is concerned. While carbon tetrachloride is an excellent solvent for grease and while it is nonflammable, its toxic properties must be considered.

Shortly over a year ago, we encountered an experience where two workers cleaned the steam drum of a boiler which was being installed in an industrial plant. The drum in question was 4½ ft in diameter and 26 ft long. The workers removed grease from holes bored in the periphery of the drum, taking approximately a day and a half to accomplish this removal. Immediately after this exposure, one of the workers was severely jaundiced but recovered. The other worker developed severe injury to his kidneys resulting in anuria. Pneumonia was a complicating factor. This man died 10 days later.

This division believes that carbon tetrachloride should never be used in an enclosed space unless proper precautions are taken to protect the persons working in those spaces. Proper precautions would include adequate ventilation or airline respirators.—JOHN B. SKINNER, director, department of labor and industries, division of occupational hygiene, Commonwealth of Massachusetts.

WANTS TO TRANSLATE SERIES OF DATA SHEETS

WE HAVE BEEN very much interested in the series of data sheets recently published in HPAC on the Simplified Procedure for Specification Writing.

Please advise us if we may have permission to translate parts of this material into Spanish in order to use it in our own specification writing.—GEORGE SCHWARZ, technical director, A. C. Fink, S.A., Mexico City.

SUPPLYING TEMPORARY HEAT WITH BASEBOARDS

REFERRING TO THE statements regarding baseboard radiation given in the report of the recent convention of the Heating, Piping and Air Conditioning Contractors National Association published in the August HPAC, temporary heat during winter construction may be had in two ways:

1) By connecting finned surface temporarily about 2 ft out from the wall, in much the same manner as with other types of radiation;

2) By installing back plate and heating unit under the plaster stop, using a protective paper over the heating unit and plastering in the normal manner.

Regarding the remarks on smudging, we have not found this to be a problem; installations which have gone through a full heating season show no evidence of as much smudging as is noticed with other types of systems. We attribute this to distribution of warm air horizontally rather than vertically from the baseboard unit.—L. D. MANDELL, vice president, C. A. Dunham Co., Chicago.

GAS CYCLING PLANT EXPANDS

Expansion of the Katy gas cycling plant, 25 miles west of Houston, one of the world's largest plants of its type, will result in a vast increase in the recovery of propane, one of the liquid petroleum gases, it was disclosed at the fall meeting of the American Society of Mechanical Engineers. Propane is sold as "bottled gas" for domestic fuel, and has many important industrial uses.

UNIVERSITY OF MICHIGAN LIBRARIES

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Are Automatic Air Shutters Justified on a Gas-Fired Conversion Burner?

By William M. Myler, Jr.* and Harlan W. Nelson,** Columbus, Ohio

SUMMARY—Automatic air shutters have generally been supplied as standard equipment on conversion-type gas burners for the purpose of saving fuel by preventing circulation of air through the boiler or furnace when the gas valve is closed.

The tests reported in this paper were run at Battelle Memorial Institute for the purpose of determining the value of automatic air shutters under operating conditions simulating those obtained in a home installation.

Based upon the results of these tests, the authors conclude that at least for a burner having a small mass of material in the combustion space, the saving in fuel is too small to justify the cost of adding the automatic air shutters to a conversion burner.

SINCE the earliest days of gas-fired conversion equipment, burners have been offered to the public both with and without automatic air shutters which were designed to close off the flow of air for combustion during the period when the burner was not in operation. Whether these automatically controlled shutters increased operating efficiency, and thereby decreased operating costs, has been argued pro and con for years. Although from time to time tests have been run trying to determine the facts about the control of *off-period* air, a search of the literature revealed no reports of comprehensive and authoritative tests.

This investigation was therefore conducted for the purpose of obtaining data from which the value of automatic air shutters might be determined.

Problems of Shutter Design

At first thought it seems like a very simple matter to provide a small door or shutter which opens and closes each time the gas valve opens and closes on a conversion burner. Experience has proved otherwise. It should be clearly understood that a closure which would have zero air leakage is not being considered.

The power for operating such a door is supplied by a valve arm extending from an electrically operated valve, or from a small gas-actuated diaphragm. The system, consisting of the door and its linkage mechanism, must be so reliable that it will operate throughout the life of the appliance which may be as much as 20 years.

The system must be rugged enough to withstand rough handling by installation and service men. It must be simple to adjust and must positively maintain that adjustment. The linkage mechanism must be so designed that if it breaks or becomes disconnected the door will fall open. Conversely, if the door gets jammed open and cannot close, the valve must still be able to close properly. If the damper remains closed for any reason the gas valve must be prevented from opening. Last, but not least, it must be inexpensive to manufacture.

General Plan of Tests

For test purposes, a conversion burner was installed in a hot water boiler of the wet-base type. The burner was fired intermittently or continuously in a program involving several variables. The variables were (1) the length of the operating cycle, (2) the percentage of *on* operation within each cycle, and (3) the position of the air shutter during *off-periods*, whether open or closed. In addition to the intermittent runs, several continuous runs were made with the excess air maintained at different percentages. This was

*Chief Engineer, Janitrol Division, Surface Combustion Corp. Member of ASHVE.

**Supervisor, Battelle Memorial Institute.

For presentation at the 55th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Chicago, Ill., January 1949.

achieved by opening the air shutter to different percentages.

The boiler was connected to obtain gravity circulation, to a copper tube heat exchanger located at a height above the boiler simulating the height of first-floor radiation above a boiler installed in a basement. Heat was dissipated from the exchanger by cooling water circulated through it by a small pump. The system was so adjusted that when the boiler was being fired continuously at rating (140,000 Btu per hr), the outlet water temperature was about 190 F and the return temperature 160 F. By maintaining the same rate of cooling water flow for intermittent tests as that established for continuous operation, a condition was obtained comparable to that in a residence.

In determining the test procedures to be followed, it was recognized that quite accurate measurements of the several factors involved in the tests would be required because it seemed probable that the magnitude of the variation in efficiency to be obtained would not be very large.

Conclusions from Test Data

The conclusions to be drawn from the data presented in this report can be summarized as follows:

1. The relationship between the *off-period* air loss with open or closed shutters, and the percentage of *on-period* time during cyclic operation, has been successfully established by direct measurement of the rate of flow and rise in temperature of the air passing through the boiler during *off-periods*.

2. The loss in sensible heat of the *off-period* air was found to decrease gradually as the percentage of *on* time within the cycle was increased. The loss at 20 percent *on* operation, expressed as percentage of total heat input, averaged 4.4 percent with the air shutters open and decreased to 1.8 percent with the shutters closed, a difference of 2.6 percent. At 66-2/3 percent *on* time, the losses with the air shutters open and closed were 1.3 and 0.7 percent, respectively, a difference of 0.6 percent.

3. The ability to determine the effect of the position of the air shutters on the overall boiler efficiency was found to be limited by the precision with which results could be duplicated for comparable tests. Excepting in results from one test, the boiler efficiencies for successive tests under identical conditions deviated from the average for each series by amounts ranging from ± 0.3 percent to ± 0.9 percent.

4. The overall boiler efficiency, expressed as percentage of heat input, was found, as expected, to increase as the percentage of *on* time was increased. Except for tests with 50 percent *on* time, the magnitude of the difference between the boiler efficiencies with the air shutters open and with them closed decreased as the percentage of time *on* became greater. The results for the closed shutter tests with 50 percent *on* time are out of line with those of all other tests. Examination of the data for these tests, and comparison with results from other tests have not revealed the cause for the discordant results.

5. Disregarding the results of the tests at 50 percent *on* time, which (as pointed out in conclusion 4) are out of line, there is excellent agreement between the *average* difference in thermal efficiency with air shutters open and closed during the *off-period* and the *average* difference in the heat loss of the *off-period* air with air shutters open and closed for the same series of tests as shown in the following table.

Percentage *On* Time	Percent Difference in Thermal Efficiency	Percent Difference in *Off-Period* Air Loss
20	2.2	2.6
33-1/3	1.4	1.5
66-2/3	0.3	0.6

6. If the differences in heat loss in the *off-period* air are weighted by the percentage of *on* time, it is found that the savings in heat from use of shutters remain almost constant when referred to the rated input of the heater. Thus $2.6 \times 0.20 = 0.52$, and $0.6 \times 0.666 = 0.40$.

Significance of the Conclusions Based on the Data

Although the data presented show that thermal efficiency is increased when *off-period* air is controlled by an automatic shutter, the more important consideration is the magnitude of the increase in efficiency. This efficiency is of concern primarily as it affects seasonal operating cost.

Taking as a typical example a house in Columbus, Ohio, that could be heated with the conversion burner used in these tests, such a well built seven room house can be heated with natural gas for approximately $100 for the entire heating season.

For the purpose of a sample calculation, let it be assumed that it costs exactly $100 to heat this house in a year when the degree-days are normal. In the last eight years the degree-days in Columbus have varied from 89 percent to 107 percent of normal, which means that the operating costs for this house varied between $89 and $107.

The heating value of the natural gas in Columbus varies as much as 5 percent, depending upon the source of supply. That accounts for another $5 variable in the annual operating cost.

Legally, a gas meter is only required to be within 3 percent of accuracy, thereby introducing another possible $3 variation in the operating cost.

Experience has shown that the average *on* time for a properly sized gas conversion burner installation will approximate 33-1/3 percent. The test data for 33-1/3 percent *on* time show a gain of 1.4 percent due to the use of automatically closing air shutters. Since the efficiency at this point was 69½ percent with the shutters open, this 1.4 percent efficiency saving becomes $\frac{1.4 \times 100}{69.5}$ 2 percent, or $2.

These normal variables which are beyond control and which affect seasonal operating costs, are much greater in magnitude than the possible saving due to control of *off-period* air. It is, therefore, concluded that it cannot be proved on an actual installation that such control has any value to a customer.

Since it cannot be proved to a customer in his own home that the use of an automatic shutter will save him money, the logical conclusion is that it should be omitted, thus saving both the cost of the development and manufacture. Also, it can be pointed out to the customer that since a mechanical gadget has been eliminated from the appliance, one possible source of operating trouble and service expense has been eliminated.

The conclusions of this report are directly applicable only to conversion burners of the type used on

UNIVERSITY OF MICHIGAN LIBRARIES

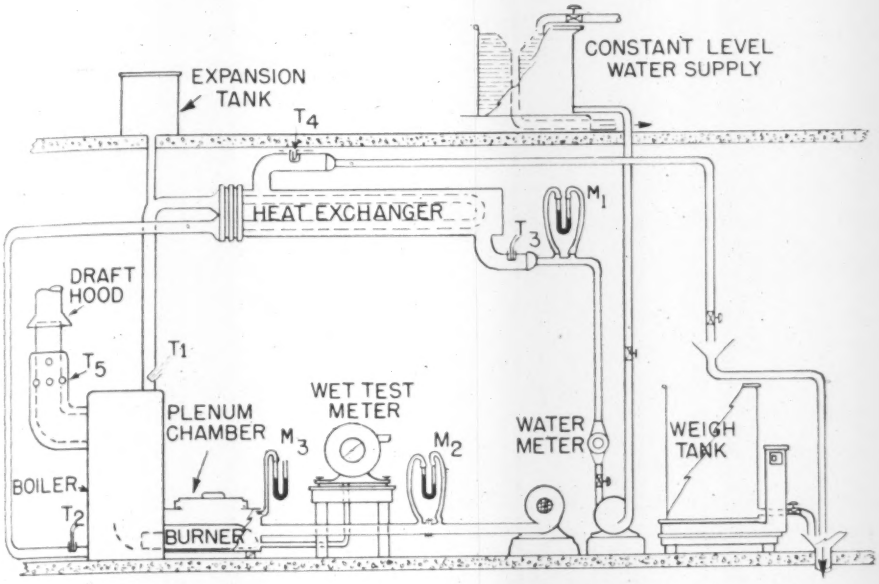


Fig. 1—General arrangement of equipment

these tests. These burners are of light weight construction; eliminating the large mass of cast iron or ceramic material characteristic of some of the conversion burners. On a continuous run, a burner having either a low mass or a high mass should give the same thermal efficiency. It is possible that a burner of heavy mass may show a greater loss due to lack of control of *off-period* air.

Test Apparatus

Fig. 1 shows the general arrangement of the equipment used in this investigation. The *inshot*[1] type conversion burner was installed in the wet-base boiler. The flow of cooling water was measured by a displacement meter which was calibrated before and after each test run.

For increased accuracy in measurement of the relatively low temperature, thermocouple installations consisted of groups of seven copper-constantan couples connected in series. Each group was individually calibrated before use.

Fuel gas was measured by the wet test meter, and temperature and pressure were recorded to permit correction of the volume to standard conditions.

To furnish a continuous record of the temperature indicated by the thermocouple installations, a 12-point temperature recorder was employed to give a continuous record of all temperatures. This also furnished a means of determining average temperature during intermittent operation.

A plenum chamber was built to house that part of the gas burner outside of the boiler, so that the flow of air into the boiler during *off-period* could be determined. This chamber was connected to a fan by a duct in which was installed a thin-plate orifice. The flow of air was so adjusted during *off-periods* as to maintain atmospheric pressure in the plenum chamber.

First Series of Tests

Test Procedure

All tests were made at a rate of heat input slightly less than 140,000 Btu per hr, the maximum input rating of the boiler. The neutral zone was kept at the same position in the furnace for all tests. At the start of each test, after adjusting the rate of gas input to the burner, the excess air was adjusted to the preassigned value by adjustment of the air shutters. The rate of flow of cooling water was adjusted and maintained at a selected value. The average of the calibration constants of the water meter obtained before and after the test was used in calculating the rate of flow of cooling water.

For the continuous tests, a warm-up period of approximately two hours was required before equilibrium conditions were obtained. The continuous record of temperatures furnished by the temperature recorder gave visual indication when this was accomplished.

Each test was started and stopped *on the run*. As all readings of the flow of gas, water and temperatures could not be made simultaneously, a time schedule was followed and each item was recorded at definite intervals. Continuous samples of the flue products were obtained and analyzed at half-hour intervals.

Intermittent tests were run in much the same way as the continuous tests. A special timer was used which could be set to give a time cycle of the desired length, and which permitted variations in the percentage *on* time to be made as required.

For the intermittent tests, the meter readings for the gas and cooling water were made at the beginning of each cycle. Samples of the flue gas were taken only during the *on* period.

During the period of each test, the heating value of the gas was determined in a Junkers-type gas calorimeter. These determinations were carefully made and checked, as a change in only a few Btu per cubic foot is directly reflected in the percentage values of the resulting heat balance.

The temperature of the water leaving and returning to the boiler was of the order of 190 F and 160 F in the continuous tests. Thus, the conditions closely approximated those of a normal residential installation.

Discussion of Results of First Series

Table 1 presents the observed and calculated results of the first series

[1] Designates a burner from which the mixture of gas and air leaves the burner in a horizontal direction.

UNIVERSITY OF MICHIGAN LIBRARIES

Table 1—Summary Data for Continuous and Intermittent Tests—First Series

Test No		7	8	6	11	12	14	13	24	23	18	17	19	16	15	21	29	25
	Units	Continuous					15-Minute Cycle								30-Minute Cycle			
Excess air	%	30	30	60	60	68	30	30	30	30	30	30	30	30	30	30	30	30
Time *on*	%	100	100	100	100	100	80	80	50	50	20	20	20	80	80	20	20	20
Air shutter position, *off* period		—	—	—	—	—	Open	Closed	Open	Closed	Open	Closed	Closed	Open	Closed	Open	Closed	Closed
Number of cycles		—	—	—	—	—	12	12	12	20	15	12	11	7	4	4	3	10
Total time of test	hr	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.13	5.05	3.89	3.02	2.79	3.5	2.0	2.02	1.51	5.04
COOLING WATER																		
Outlet temperature	F	160.6	160.3	157.4	153.0	148.2	131.9	132.7	94.3	95.2	80.9	77.0	80.4	135.2	135.8	77.0	80.8	69.7
Inlet temperature	F	68.8	69.2	70.7	65.9	60.4	61.1	61.8	50.9	49.6	62.1	58.5	61.6	61.8	63.5	57.4	61.3	51.1
Heat output	Btu	305.365	303.978	289.702	289.346	289.582	231.661	234.153	149.210	254.255	81.597	61.618	58.979	282.917	160.590	43.005	32.693	101.004
GAS																		
Total heat input	Btu	410.591	409.880	417.434	412.547	417.583	325.637	326.603	213.520	353.921	121.365	92.657	85.699	390.191	223.484	64.854	47.657	150.220
FLUE LOSS, *ON*																		
Average flue-gas temperature	F	538	538	575	575	577	515	525	483	482	443	425	420	533	524	455	470	435
Room temperature	F	73.7	74.6	72.9	75.4	74.6	75.7	75.1	74.9	72.3	77.8	75	78.7	74	78	77	77	67
Average O_2 content	%	4.8	4.7	8.4	8.2	8.8	4.6	4.9	4.7	4.8	4.8	4.8	6.0	4.6	4.8	4.7	5.1	5.0
Flue loss, from chart	%	21.4	21.3	25.4	25.1	25.8	20.6	21.0	19.9	20.0	18.9	18.4	18.8	21.1	20.9	19.1	19.7	19.0
AIR LOSS, *OFF*																		
Average flue temperature	F	—	—	—	—	—	282	—	209.7	222	153.4	—	156.3	251	—	137	141	134
Room temperature	F	—	—	—	—	—	75.7	—	74.9	72.3	77.8	—	78.7	74.4	—	77	77	67
Total *off-period* time	hr	—	—	—	—	—	0.43	—	1.59	2.49	3.08	—	2.2	0.64	—	1.59	1.20	4.0
Average air flow into boiler	lb hr	—	—	—	—	—	92.5	—	130.7	56.6	63.8	—	30.3	81.8	—	119.2	56.0	43.7
Loss for total *off* time	B u	—	—	—	—	—	1951	—	6667	5023	3536	—	1231	2200	—	2713	1023	2803
Off-period air loss	%	—	—	—	—	—	0.6	—	3.1	1.4	2.9	—	1.4	0.6	—	4.2	2.2	1.90
SUMMARY, HEAT BALANCE																		
Boiler output	%	74.4	74.2	69.4	70.1	69.3	71.1	71.7	69.9	71.8	67.2	66.5	68.8	72.5	71.9	66.3	68.6	67.2
Flue loss, *on* period	%	21.4	21.3	25.4	25.1	25.8	20.6	21.0	19.9	20.0	18.9	18.4	18.8	21.1	20.9	19.1	19.7	19.0
Air loss, *off* period	%	—	—	—	—	—	0.6	—	3.1	1.4	2.9	—	1.4	0.6	—	4.2	2.2	1.9
Radiation, etc., losses	%	4.2	4.5	5.2	4.8	4.9	7.7	7.3	7.1	6.8	11.0	15.1	11.0	5.8	7.2	10.4	9.5	11.9

of tests made in this investigation. A summary heat balance is shown for each test at the bottom of the column.

A heat balance, in which the heat in the flue gas is divided between the sensible heat in the dry gas and the heat in the steam, could not be calculated, as an analysis of the natural gas was not made. Furthermore, the flue-gas temperatures obtained may not be exact. The primary purpose of the couples as installed was to obtain temperatures for comparison and control. Shielded or possibly high-velocity thermocouples might be necessary for exact measurements.

Of the several items involved in the heat balance, the total heat input and the boiler output were determined directly. When determined, the *off-period* air loss likewise was found directly from observed data. The sensible heat loss of the wet products of combustion leaving the boiler was determined by use of a chart of flue losses for a natural gas of *normal* composition. It involved the temperature and oxygen content of the flue gas. The flue losses determined in this way, although indirect and possibly not precise, are believed to give results of sufficient accuracy for purposes of relative comparison between tests. The radiation and unaccounted-for losses were determined by difference.

Continuous Tests

Five continuous tests were made, each of three hours' duration. Of these, Tests Nos. 7 and 8 were made with 30 percent excess air, Tests Nos. 6 and 11 with 60 percent excess air, and Test No. 12 with 68 percent excess air, which was the maximum obtainable with the shutters fully opened. The data and calculated results are shown in Table 1 under these test numbers.

The effect of changing the percentage of excess air on the results of the continuous tests is shown in the summary heat-balance results in Table 1. As was to be expected, the boiler efficiency values decreased as the percentage of excess air was increased, and the flue losses increased.

Intermittent Tests

Table 2 summarizes the heat balances of the series of intermittent

tests in which the effect of leaving the air shutters open or closed in the *off-period* was investigated for cycles of 15 and 30 min and for varying percentages of time *on* in each cycle.

Effect of Open or Closed Shutters

With the exception of the tests at 80 percent *on* in the 30-min cycle where the efficiency was 0.6 percent higher with the shutters open than closed, and in one of the repeat tests with the shutters closed at 20 percent *on* in the 15-min cycle where the efficiency was 0.7 percent less than with the shutters open, the efficiency was definitely, though only slightly, higher when the shutters were closed in the *off-period* than when they were open.

The loss in sensible heat in the air passing through the boiler in the *off-period* was not measured in all tests with the shutters closed, but in those pairs of tests where it was measured, the difference in the loss was nearly the same as the difference in efficiency.

The reason for the small difference in the loss in the air flowing through the boiler in the *off-period*, whether the shutters were open or closed, can be seen by reference to the data in Table 1. Although the measured average rate of air flow through the boiler with the shutters open was about twice the flow with the shutters closed, the temperature of this air in the flue was so low for either condition that the total heat loss was small. Hence the differences could not be large.

Second Series of Tests

Twenty-four complete efficiency tests were run in this series.

Test Apparatus and Procedure

The same general arrangement of the apparatus and equipment was used as in the earlier tests. Several minor changes in instrumentation were made in an effort to obtain more exact and reliable data.

For increased accuracy in measurement of the relatively small volume of air flowing through the boiler during the *off-period*, precision-type inclined micromanometers of improved accuracy in reading and manipulation were substituted for those used during the original series of tests. In addition, a more sensitive zero gage for indicating maintenance of atmospheric pressure conditions within the plenum chamber was substituted for the gage formerly used.

To give easier and more positive draft control, and to offset the effect of fluctuations of draft in the breeching duct, because of the load placed on it by other laboratory installations made since the original series of tests, a butterfly damper and barometric damper were inserted between the drafthood and breeching. A precision-type inclined micromanometer was utilized to determine the magnitude of draft conditions within the stack.

To minimize the possibilities of error in measurement of inlet and outlet cooling water temperatures, and thereby to give more accurate determinations of thermal output, a high sensitivity type portable precision potentiometer was used instead of the 12-point potentiometer recorder employed for the original tests.

Special precautions were taken to maintain constant the rate of heat input, the percentage of excess air, the rate of flow of cooling water, and the time schedule for all readings.

All tests were run on a 15-min cycle of operation, with 30 percent excess air, constant rates of heat input during *on-periods*, and constant flow of cooling water in the heat exchanger at all times. The percentage of *on* time within the operating cycle and the position of the air shutters during *off-periods*, whether open or closed, were varied as required by the schedule of tests.

Determination of Heat Balance

No changes were made in the original method for determination of the thermal efficiency of the boiler or *off-period* air loss. The semi-calorimetric method previously described was used to determine the boiler efficiency. The actual *off-period* air loss as sensible heat was determined by measuring the rate of flow of air and its rise in temperature in passing through the boiler during the *off-period*.

Schedule of Tests

For the determination of the overall boiler efficiency and *off-period* air losses during the performance of the original series of tests employing cyclic operation, tests had been run at 80, 50 and 20 percent *on-period* time. Duplicate tests had been run in only two instances.

In order to establish more definitely the effect of decreasing percentages of *on-period* time, additional tests at 33-1/3 and 66-2/3 percent *on* time also were planned

Table 2—Summary of Heat-Balance for Intermittent Tests
(30 Percent Excess Air)

	80 Percent *on*		50 Percent *on*		20 Percent *on*		
Percentage of Heat Input—15-min cycle	Shutters Open	Shutters Closed	Shutters Open	Shutters Closed	Shutters Open	Shutters Closed	
Test No.	14	13	24	23	18	17	19
Boiler Efficiency	71.1	71.7	69.9	71.8	67.2	66.5	68.8
Flue Loss *on*	20.6	21.0	19.9	20.0	18.9	18.4	18.8
Flue Loss *off*	0.6	——	3.1	1.4	2.9	——	1.4
Radiation, etc. losses by diff.	7.7	7.3	7.1	6.8	11.0	15.1	11.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Percentage of Heat Input—30-min cycle							
Test No.	16	15			21	20	22
Boiler Efficiency	72.5	71.9			66.3	68.6	67.2
Flue Loss *on*	21.1	20.9			19.1	19.7	19.0
Flue Loss *off*	0.6	——			4.2	2.2	1.9
Radiation by diff.	5.8	7.2			10.4	9.5	11.9
TOTAL	100.0	100.0			100.0	100.0	100.0

Table 3—Summary Data for "a" and "b" Tests—Second Series, 15-min Cycles

Test Number	Units	3a	9a	10a	1b		4a	15a	16a	17a	
Excess air	%	30	30	30	30		30	30	30	30	
Time *on*	%	20	20	20	20		20	20	20	20	
Air shutter position, *off* period		Closed	Closed	Closed	Closed		Open	Open	Open	Open	
Number of cycles		18	18	14	14		17	18	16	16	
Total time of test	hr	4.6	4.6	3.5	3.6		4.3	4.6	4.0	4.1	
COOLING WATER											
Outlet temperature	F	84.9	88.8	86.8	103.8		81.5	96.7	98.3	100.6	
Inlet temperature	F	65.7	68.5	67.2	83.2		62.9	76.9	79.0	81.4	
Heat output	Btu	96,797	103,778	76,893	90,340		87,980	100,094	86,084	88,554	
GAS											
Total heat input	Btu	135,753	145,448	106,644	126,677		131,972	143,924	121,386	126,087	
FLUE LOSS, *ON*											
Average flue-gas temperature	F	446	448	444	465		441	458	456	457	
Room temperature	F	77.6	76.5	75.6	83.3		75.4	86.7	86.1	83.2	
Average O_2 content	%	5.7	5.3	5.1	4.7		5.5	4.7	5.0	5.0	
Flue loss, from chart	%	19.4	19.2	19.1	19.4		19.2	19.4	19.5	19.7	
AIR LOSS, *OFF*											
Average flue temperature	F	177	178	177	201		170	187	184	208	
Room temperature	F	77.6	76.5	75.6	83.3		75.4	86.7	86.1	83.2	
Total *off-period* time	hr	3.62	3.59	2.79	3.22		3.39	3.58	3.16	3.24	
Average air flow into boiler	lb/hr	28.6	29.0	28.0	29.1		72.2	68.0	67.6	69.1	
Loss for total *off* time	Btu	2450	2520	1890	2614		5530	5800	4920	6650	
Off-period air loss	%	1.8	1.7	1.8	2.0		4.2	4.0	4.0	5.3	
SUMMARY, HEAT BALANCE						Avg.					Avg.
Boiler output	%	71.3	71.4	72.1	71.3	71.5	66.7	69.5	70.9	70.2	69.3
Flue loss, *on* period	%	19.4	19.2	19.1	19.4	19.3	19.2	19.4	19.5	19.7	19.5
Air loss, *off* period	%	1.8	1.7	1.8	2.0	1.8	4.2	4.0	4.0	5.3	4.4
Radiation, etc., losses	%	7.5	7.7	7.0	7.3	7.4	9.9	7.1	5.6	4.8	6.8

Test Number	Unit	8a	2b	7a	3b		5a	5b	6a	6b	
Excess air	%	30	30	30	30		30	30	30	30	
Time *on*	%	33⅓	33⅓	33⅓	33⅓		66⅔	66⅔	66⅔	66⅔	
Air shutter position, *off period*		Closed	Closed	Open	Open		Closed	Closed	Open	Open	
Number of cycles		16	16	16	16		12	12[a]	12	12	
Total time of test	hr	4.0	4.0	4.0	4.0		3.0	3.0	3.0	3.0	
COOLING WATER											
Outlet temperature	F	98.8	113.7	99.2	113.1		124.7	140.3	125.9	142.0	
Inlet temperature	F	68.7	82.5	68.6	81.5		66.8	80.8	69.3	82.2	
Heat output	Btu	132,065	135,873	135,424	139,880		191,573	197,203	188,745	197,373	
GAS											
Total heat input	Btu	187,009	190,900	197,445	198,896		273,905	278,759	271,253	279,848	
FLUE LOSS, *ON*											
Average flue-gas temperature	F	472	502	486	502		535	555	521	531	
Room temperature	F	81.3	83.5	77.1	86.1		77.0	82.6	79.9	85.0	
Average O_2 content	%	4.9	5.5	5.5	4.6		5.6	5.4	5.6	5.2	
Flue loss, from chart	%	19.8	20.5	20.5	20.0		22.2	22.0	21.2	21.1	
AIR LOSS, *OFF*											
Average flue temperature	F	213	234	207	222		306	320	281	283	
Room temperature	F	81.3	83.5	77.1	86.1		77.0	82.6	79.9	85.0	
Total *off-period* time	hr	2.62	2.58	2.62	2.62		0.974	0.974	0.959	0.953	
Average air flow into boiler	lb/hr	30.8	32.3	73.6	72.0		33.2	36.0	78.9	82.0	
Loss for total *off* time	Btu	2528	2991	5950	6048		1755	1980	3620	3670	
Off-period air loss	%	1.4	1.6	3.0	3.0		0.6	0.7	1.3	1.3	
SUMMARY, HEAT BALANCE						Avg.					Avg.
Boiler output	%	70.6	71.2	70.9	68.6	70.4	69.5	69.9	70.7	70.3	69.6	70.5	70.0
Flue loss, *on* period	%	19.8	20.5	20.1	20.5	20.0	20.2	22.2	22.0	22.1	21.2	21.1	21.2
Air loss, *off* period	%	1.4	1.6	1.5	3.0	3.0	3.0	0.6	0.7	0.7	1.3	1.3	1.3
Radiation, etc., losses	%	8.2	6.7	7.5	7.9	6.6	7.3	7.3	6.6	6.9	7.9	7.1	7.5

Test Number	Units	1a	4b	7b		2a	12a	11a	13a	14a	
Excess air	%	30	30	30		30	30	30	30	30	
Time *on*	%	50	50	50		50	50	50	50	50	
Air shutter position, *off period*		Closed	Closed	Closed		Open	Open	Open	Open	Open	
Number of cycles		17	14	12		16	18	18	14	16	
Total time of test	hr	4.3	3.5	3.0		4.1	4.5	4.5	3.5	4.0	
COOLING WATER											
Outlet temperature	F	110.7	129.5	123.2		108.3	119.7	115.1	122.6	118.6	
Inlet temperature	F	66.4	82.8	80.3		64.9	76.0	70.9	76.4	74.2	
Heat output	Btu	207,418	171,667	140,556		195,526	215,205	216,916	178,109	197,638	
GAS											
Total heat input	Btu	302,384	252,520	208,245		278,876	310,626	307,396	254,324	278,375	
FLUE LOSS, *ON*											
Average flue-gas temperature	F	515	502	514		502	498	533	513	496	
Room temperature	F	78.6	88.4	87.1		79.2	82.1	78.7	82.3	80.3	
Average O_2 content	%	5.5	5.0	5.3		5.7	5.1	5.1	5.1	5.2	
Flue loss, from chart	%	21.0	20.2	20.6		20.9	20.3	20.7	20.6	20.2	
AIR LOSS, *OFF*											
Average flue temperature	F	257	249	266		231	237	231	242	232	
Room temperature	F	78.6	88.4	87.1		79.2	82.1	78.7	82.3	80.3	
Total *off-period* time	hr	2.09	1.70	1.50		2.01	2.20	2.21	1.69	1.94	
Average air flow into boiler	lb/hr	31.3	33.2	34.0		81.5	78.0	77.0	81.8	75.4	
Loss for total *off* time	Btu	2771	2154	2172		5915	6308	6160	5260	5240	
Off-period air loss	%	1.0	0.9	1.0		2.1	2.0	2.0	2.1	1.9	
SUMMARY, HEAT BALANCE					Avg.						Avg.
Boiler output	%	68.6	68.0	67.5	68.0	70.1	69.3	70.6	70.0	71.0	70.2
Flue loss, *on* period	%	21.0	20.2	20.6	20.6	20.9	20.3	20.7	20.6	20.2	20.5
Air loss, *off* period	%	1.0	0.9	1.0	1.0	2.1	2.0	2.0	2.1	1.9	2.0
Radiation, etc., losses	%	9.4	10.9	10.9	10.4	6.9	8.4	6.7	7.3	6.9	7.3

[a] Equilibrium conditions maintained for 16 cycles—no data for five cycles

UNIVERSITY OF MICHIGAN LIBRARIES

for the second series of tests. Because a gas burner is rarely operated on an 80 percent *on* time schedule, no additional tests at this percentage were scheduled. The tests originally planned for the second series were single tests at 66-2/3, 50, 33-1/3 and 20 percent *on* time within 15-min schedules, with the air shutters open, and a similar series with them closed.

Several inconsistencies were found in the results for these tests, and it was decided to make a series of duplicate tests in an effort to establish the reproducibility of the calculated results. Some of the tests were repeated a number of times.

Discussion of Results of Second Series

Table 3 presents a summary of the observed and calculated data obtained in the second series of tests. For each test the data are divided horizontally into six sections, each containing data relating to miscellaneous items, cooling water, gas, flue loss, air loss, and a summary heat balance.

Effect of Open or Closed Shutters

Fig. 2 is a graphical representation of data from Table 3. The changes in boiler efficiency, flue loss, radiation loss and *off-period* air loss, expressed as percentage of total heat input, are shown in relation to percentages of *on* time. The plot was constructed using average values for each series of tests. Data from the first series of tests were used for 80 and 100 percent *on* time.

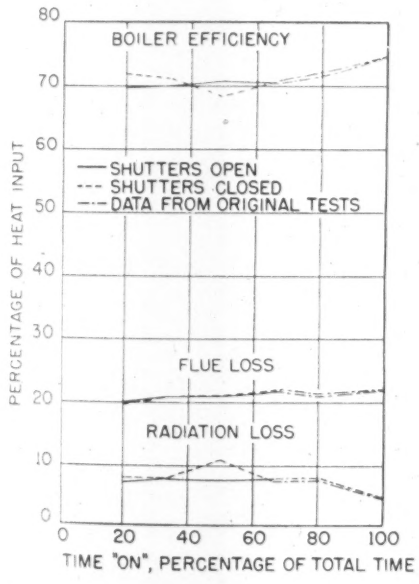


Fig. 2—Effect of varying the percentage *on* time in a 15-min cycle. Based on percentage of total heat input

For tests performed with the shutters open, the increase in boiler efficiency with increase in percentage *on* time is small, but fairly regular. For the tests with the shutters closed, however, the average value for the tests at 50 percent *on* time is obviously out of line, as compared with the values for other series of tests. To check this value, three complete tests were made, with extreme care taken in flow measurement, time regulation, and recording of data. For these tests, the deviation of the thermal efficiency from the average was ± 0.5 percent.

As the average percentage radiation loss for these same tests is out of line, practically to the same extent as the boiler efficiency, and since the radiation losses were obtained by difference, it must be concluded that, for some unexplained reason, the boiler efficiencies are several percent too low. A careful examination of the data furnished no explanation for the deviation shown in the plot. The tests were not run consecutively.

If the value for the 50 percent *on* tests, shutters closed, is disregarded, the plots for percentage boiler efficiencies, Fig. 2, show the following trends: (1) the boiler efficiency increases slightly as the percentage *on* time is increased, (2) the increase is somewhat less than indicated by results of the single determinations shown in Table 1, and (3) the percentage boiler efficiencies for those tests with the shutters closed are slightly higher than comparable tests with the shutters open, but the differences are relatively small.

The flue loss, expressed as a percentage of the total heat input, is shown in Fig. 2 to increase gradually, but to a very small extent, as the percentage of *on* time is increased.

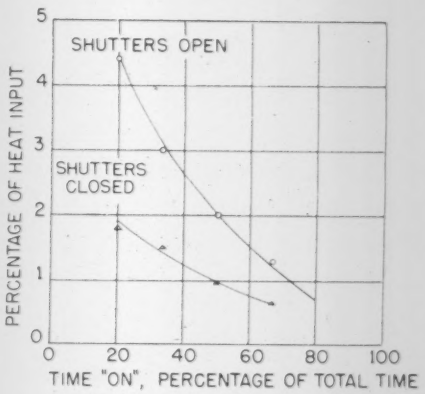


Fig. 3—Effect on *off-period* air loss when varying the percentage *on* time in a 15-min cycle. Based on percentage of total heat input

Disregarding the value at 50 percent *on* time, with the air shutters closed, the radiation losses shown in the plot remain fairly constant over the range of percentage time *on* from 20 to 80 percent.

Fig. 3 shows the *off-period* air loss, which decreases regularly as the percentage of *on* time increases. It is evident that the direct determination of the *off-period* air loss by measuring the flow of air and its temperature in passing through the boiler, furnishes a reliable method for evaluation of the magnitude of the air loss, and for evaluation of the loss of heat energy occasioned by not closing the air shutters during *off-period*.

The air losses determined by the direct method with the shutters open are about twice those with the shutters closed. The losses are, however, small for either condition. The results confirm the conclusion reached in the first series of tests.

Table 4—Comparison of the Magnitude of Differences in Percentage of *Off-Period* Air Loss for Open and Closed Air Shutters, as Determined by Two Methods at Several Percentages of *On* Time

On Time, Percent	Difference By Direct Determination, Percent	By Difference in Boiler Efficiency, Percent
20	2.6	2.2
33⅓	1.5	1.4
50	1.0	—
66⅔	0.6	0.3

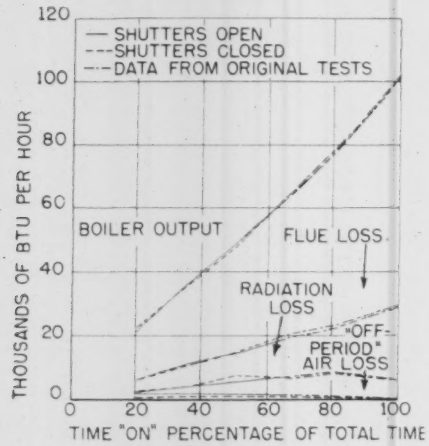


Fig. 4—Effect of varying the percentage *on* time in a 15-min cycle. Based on actual values of Btu per hour input

Table 4 shows a comparison of the magnitude of differences in percentage values for the *off-period* air loss for open and closed shutters, as determined by the direct method and by the difference in calculated boiler efficiencies. The differences are shown for several percentages of *on* time. Because of the seeming abnormality of the determinations of boiler efficiency for 50 percent *on* time operation with the shutters closed, no comparison is possible. However, for all other percentages of *on* time, the agreement between the two methods is good.

The directly determined difference in sensible heat loss between that with shutters open and that with shutters closed remains rather constant over the range of percentage *on* times when referred to the rated input of the heater. For example, at 20 percent *on* time, the additional rate of loss is 2.6 × 0.20 = 0.52 percent of rated input; at 66-2/3 percent *on* time, the additional rate of loss is 0.6 × 0.66 = 0.40 percent of rated input. Thus, over a range of partial loads the savings in heat from the use of shutters are nearly constant and are small.

Fig. 4 shows a plot of the change in boiler output, flue loss, radiation loss, and *off-period* air loss, in terms of Btu per hour, with changing percentages of *on* time.

Possible Errors

A discussion of possible errors in testing as prepared for the original report will be published with this paper in the ASHVE TRANSACTIONS for 1949.

Acknowledgment

This paper is a report of data obtained and conclusions reached in a series of tests sponsored by the Surface Combustion Corp. at Battelle Memorial Institute, Columbus, Ohio.

COOPERATION PLANNED BY ORGANIZATIONS IN LOS ANGELES

Representatives of five organizations in the field of air conditioning and refrigeration met in Los Angeles recently to develop meeting programs for the coming season to coordinate plans and eliminate duplication.

Those present were: R. N. Gay and N. S. Templin, *Refrigeration Contractors Association*, R. S. Farr and J. L. Blake of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, R. M. Westcott and G. S. Wheaton of the *American Society of Refrigerating Engineers*, Regis Gubser and D. H. Byl of the *National Association of Practical Refrigerating Engineers*, and Paul Kieffer and Harold Halls of the *Refrigeration Service Engineers Society*.

Because of some overlapping of membership, it was proposed to schedule one joint meeting of the groups during the year, with a nationally known guest speaker. Where the topic programmed by one group would interest one or more of the others, a joint meeting would be held. It is hoped that this plan will result in better and more interesting meetings, with larger attendance.

NATIONAL RADIATOR APPOINTMENTS

The National Radiator Co., Johnstown, Pa., announces the election of Carroll M. Baumgardner as vice president. Mr. Baumgardner was formerly executive vice president and director of United States Radiator Corp., Detroit, Mich. He is a member of the ASHVE, chairman of the Executive Committee of the *Institute of Boiler and Radiator Manufacturers* and a director of the Plumbing and Heating Industries Bureau, Chicago, Ill.

Benjamin T. Hain has been appointed general manager for manufacturing in charge of National Radiator Co. plants in Johnstown, Pa., New Castle, and Middletown, Pa., and in Trenton, N. J. For 16 years he was factory manager of the American Radiator and Standard Sanitary Corp. plant in Buffalo, N. Y.

PERSONALS

W. W. Carder, Atlanta, Ga., has been appointed direct factory representative in the southeastern area for the J. A. Zurn Mfg. Co., Erie, Pa. Previously he was manager of the Atlanta office of the Johnson Service Co. for a number of years.

Alvin H. Moraweck, Jr., has recently joined the New York office of Powers Regulator Co. Mr. Moraweck was formerly employed with the Abbott Co., Newark, N. J.

John G. Skidmore has been appointed assistant mechanical engineer, Design Division, The Port of New York Authority, New York. He was formerly with the Almirall & Co., Inc., New York, N. Y.

Edward C. Smyers, Pittsburgh, Pa., announces the opening of his own office for the engineering and sale of automatic control equipment at 223 Water St. He will act as representative for Barber-Colman Co. on automatic controls and air distribution equipment. Mr. Smyers was associated for over 20 years with T. F. Campbell Co.

UNIVERSITY OF MICHIGAN LIBRARIES

Performance of Fourteen Masonry Chimneys Under Steady State Conditions

By Paul R. Achenbach* and Selden D. Cole,** Washington, D. C.

SUMMARY—A report of tests conducted at the National Bureau of Standards to determine the performance of 14 chimneys of various types of construction under conditions simulating those obtained in domestic chimneys. Tests were made at 200, 600 and 1000 F inlet temperature, and at gas flow rates of 20, 45 and 70 cfm, corresponding to a fuel burning rate of ½, 1 and 1½ gal of fuel oil per hour, respectively.

The constructions selected for the various chimneys permitted comparison of brick chimney performance with others in which such materials as shale tile, cinder concrete blocks and the fire clay or metal liners were used. All chimneys were approximately 15.5 ft high from inlet to top, and were exposed above the roof for one-third of the height.

Conclusions drawn from tests provide useful information for selection of chimney material and type of construction.

Introduction

A CHIMNEY has two characteristics of prime importance, aside from considerations of cost and appearance, namely, the magnitude of the draft it will produce and its ability to convey gases at high temperature without igniting combustible materials in the structure of which it is a part. The *National Board of Fire Underwriters* has accepted chimneys made of solid brick, concrete, solid-molded or solid-cast concrete chimney units, or burned clay, during the past several years for warm-air, hot-water, or low-pressure steam heating systems. Walls 8 in. thick are required if the chimney is unlined, and walls 3¾ in. thick may be used if a suitable lining is provided. The drafts produced by lined brick chimneys of the cross-sectional areas and heights usually found in domestic use were determined at the *National Bureau of Standards* and are now published in THE GUIDE of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. However, the construction of small dwellings on a mass production basis in recent years has created a demand for chimney materials that would be cheaper, more easily erected, lighter in weight, or for some other reason more advantageous to use than brick.

When construction materials other than brick are used for a chimney, the question naturally arises whether such a chimney is the equivalent of a brick chimney as a draft producer and in fire-resistance properties. In order to provide information on various types of chimney materials, 14 chimneys of equal height were constructed at the *National Bureau of Standards* using brick, shale tile, and cinder concrete blocks with fire clay and metal liners.

Object of Investigation

The objectives of the investigation were as follows:

1. Measurement of the draft produced by chimneys made of the various materials under steady state conditions for a range of mass flows of the flue gases and for a range of temperatures.

2. Comparison of the draft produced by metal-lined chimneys and refractory-lined chimneys.

3. Comparison of the performance of round and rectangular flue liners of equal cross-sectional area and of round and square flue liners of equal principal dimensions.

4. Measurement of the effect on the draft produced when one of two contiguous liners in the same chimney carried hot gases while the other was open.

5. Observation of the effect on the draft produced when the base of a chimney was sealed at the bottom of the thimble.

6. Determination of the effect of grouting in the liner with mortar on the available draft.

Tests were made of the several chimneys for entering flue-gas temperatures of 200 F, 600 F, and 1000 F, and for gas-flow rates of 20, 45, and 70 cfm computed for a temperature of 70 F and a barometric pressure of 29.92 in. Hg. The equivalent mass-flow rates approximate those obtained when fuel oil is burned at rates of ½, 1, and 1½ gal per hr with 8 to 10 percent carbon dioxide in the flue gases as shown in Table 1. This range of conditions was considered to cover the operating conditions likely to occur in domestic chimneys of the sizes used. The gas-flow rates used could readily be converted into equivalent coal consumption rates by applying suitable factors for the weight of air supplied per pound of coal burned.

It was desirable to compare the performance of all the chimneys

Table 1—Combustion equivalents of flue-gas flow rates

Fuel oil rate gal/hr	CO_2 in flue gas by volume percent	Gas flow at standard conditions[1] cfm
½	10	18.4
½	8	22.5
1	10	36.8
1	8	45.0
1½	10	55.2
1½	8	67.5

[1] 70 F and 29.92 in. Hg.

* Assistant Chief, Heating and Air Conditioning Section, *National Bureau of Standards*. Member of ASHVE.

** Mechanical Engineer, Heating and Air Conditioning Section, *National Bureau of Standards*.

For presentation at the 55th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Chicago, Ill., January 1949.

under identical atmospheric conditions. Since the tests could not all be made with the same outside temperature and barometric pressure, the observations were corrected for an outdoor temperature of 32 F and a pressure of one standard atmosphere. The formula used for making these corrections was

$$S_2 - S_1 = O_2 - O_1 \quad \ldots\ldots\ldots (1)$$

where

S_1 = computed static draft or theoretical draft under the conditions of the test.

S_2 = computed static draft under the standard conditions.

O_1 = observed draft under the experimental conditions.

O_2 = corrected draft that should have been observed under standard conditions.

The relation in Equation 1 develops if the friction of a given chimney remains constant for the same mass flow and the same entering temperature at the experimental conditions and at the standard conditions. All tests were made at times when there was a negligible movement of air around the chimney.

The static draft or theoretical draft of a chimney was computed from the following expression

$$D = \frac{dH(T_1 - T_2)}{5.2\,T_1} \quad \ldots\ldots\ldots (2)$$

where

D = static draft, inches water gage (in. W.G.).

d = mean density of atmospheric air at time of test, pounds per cubic foot.

H = effective height of the chimney, feet.

T_1 = mean temperature of gases in the chimney, Fahrenheit degrees absolute.

T_2 = mean temperature of outdoor air, Fahrenheit degrees absolute.

It was assumed, for the purpose of this computation, that the flue gas had the same density as atmospheric air at the same temperature and pressure.

Description of Chimneys

Each of the 14 chimneys differed in some respect from the others as to the size, shape, or material of the flue liner; the treatment of the space between liner and inside face of the masonry; or the material used in forming the masonry chimney wall. Each chimney was like the others in having about two thirds of its height inside a building and one third exposed above the roof. Each had a single thick wall of masonry laid up in a mortar of 1:1:5 mix of hydrated lime, cement, and sand and each had a round metal or tile thimble. A photograph of the structure in which the tests were made showing the chimneys protruding through the roof is shown as Fig. 1. The height of the several chimneys from the center of the thimble to the top ranged from 15.2 to 15.6 ft, except one of the two liners in chimney 3 which was 16.2 ft in height.

The materials used in each chimney and the treatment of the air space around the liner are described in following paragraphs. The flue liners have been designated by their nominal internal dimensions for ease in comparing the cross-sectional areas of the several specimens.

Chimney 1. Common brick having 6 core holes, 11/16 in. diam, 7- by 11-in. fire clay flue liner surrounded by air space, 8 in.-diam metal thimble.

Chimney 2. Common brick, 7- by 11-in. fire clay flue liner grouted in with mortar, 8 in.-diam metal thimble.

Chimney 3. Common brick, two 7- by 11-in. fire clay liners contiguous to each other and surrounded with an air space, and two 8 in.-diam fire clay thimbles on the same face of the chimney. This construction resulted in one flue being 16.2 ft high.

Chimney 4. Common brick, 10 in.-diam fire clay flue liner surrounded by an air space, 8 in.-diam thimble of tile.

Chimney 5. Shale multicored tile 3⅝ in. by 4 in. by 12 in. in size, 7- by 11-in. fire clay liner surrounded by an air space, 8 in.-diam thimble of tile.

Chimney 6. Fire clay multicored tile 4 in. by 5 in. by 12 in. in size, 7- by 11-in. fire clay tile liner surrounded by an air space, 8 in.-diam thimble of tile.

Chimney 7. Shale partition tile having webs and shells approximately 9/16 in. thick, 7- by 11-in. fire clay tile liner with an air space, 8 in.-diam thimble of tile.

Chimney 8. Common brick, 7 in.-diam fire clay liner with air space filled with expanded mineral matter insulation weighing about 3 lb per ft³ for insulation, 7 in.-diam integral tile thimble.

Chimney 9. Common brick, 7 in.-diam enameled steel flue liner with air space filled with expanded mineral matter insulation, 7 in.-diam integral enameled steel thimble.

Chimney 10. Cinder concrete building block having two cells, 7- by 7-in. fire clay flue liner with an air space, 7 in.-diam thimble of tin.

Chimney 11. Same as chimney 10 except that solid cinder concrete blocks were used.

Chimney 12. Cinder concrete chimney unit blocks 17 by 22 by 8 in., designed to be used with 7- by 11-in. fire clay liner. Except for a spacing boss at the midlength of each side, the liner was spaced ¾ in. from the interior of the unit.

Chimney 13. Cinder concrete chimney unit blocks 16 by 16 by 8 in., 7- by 7-in. fire clay liner grouted in solid with mortar, 7 in.-diam thimble of tile.

Chimney 14. Same as chimney 13 except that the liner was grouted only at the joints.

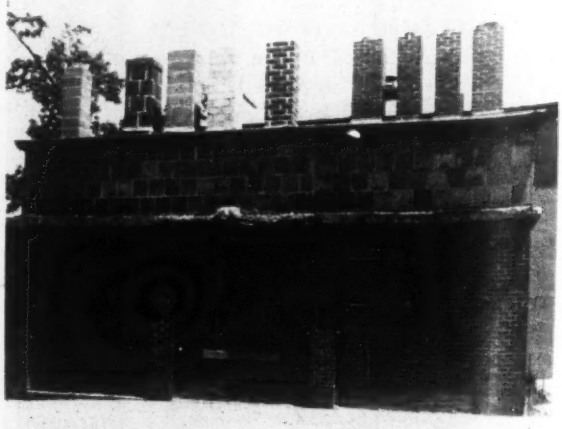


Fig. 1—Test structure and chimneys

An elevation view of a typical chimney is shown in Fig. 2. It will be noted in this figure that all but the top 5½ ft of the chimney was surrounded by air at room temperature. Fig. 3 is a photograph of the lower parts of chimneys 6, 7 and 12 showing the different materials of construction above the thimbles. The bases of the chimneys shown were not of the same materials as the portion above the thimbles.

Fig. 3—View of chimneys 6, 7 and 12 showing bases, thimbles and construction above base

Test Equipment and Procedure

The method used for the tests consisted of blowing air through a calibrated orifice, thence over a gas burner into the chimney. The orifice was used for measuring the volume of air and the volume of gas used was measured with a dry gas meter. A small centrifugal blower was used to overcome the pressure drop of the orifice. The system was sealed against extraneous air leakage and the pipe was insulated with 4-in. rock-wool batts from the burner to the chimney to obtain nearly uniform flue-gas temperature across the pipe. A view of one of the sets of equipment is shown in Fig. 4 in a typical position attached to chimney 6. As there were 7- and 8 in.-diam thimbles in the test chimneys, two duplicate sets of equipment were constructed so that simultaneous tests of two specimens could be made.

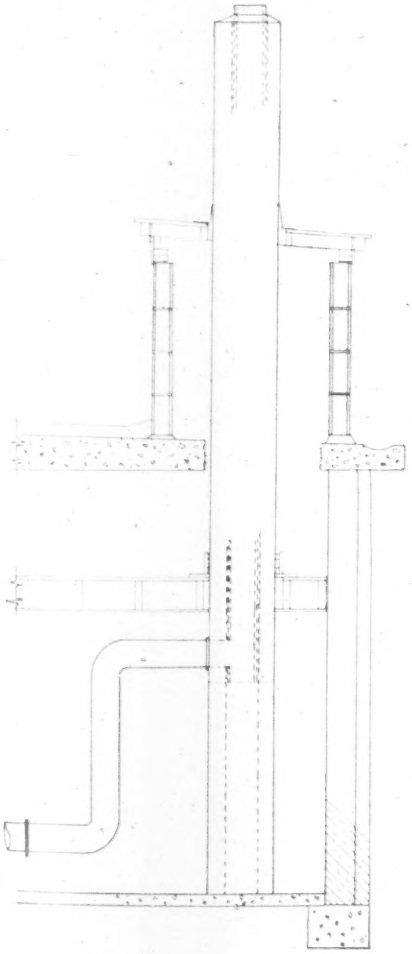


Fig. 2—Elevation of typical chimney

The draft tube entered the smokepipe 1 ft from the face of the chimney. The axis of the tube was normal to the flow of gases. The draft was observed on a calibrated inclined gage graduated in thousandths inch water gage (W.G.). All inclined gages were calibrated with a Wahlen differential manometer after being rigidly mounted on the brick wall of the building.

Temperatures in the chimney and smokepipe were measured with unshielded thermocouples of chromel-alumel wire, and an automatic, indicating, electronic potentiometer which could easily be read to 1 F deg. Thermocouples were inserted through sleeves in the chimney and smokepipe to the center of the gas stream in the following stations:

Station 1. In the smokepipe in a plane 1 ft from the chimney face, but at right angles to the draft tube.

Station 2. In the chimney about 1 ft above the center of the thimble.

Station 3. In the chimney midway between ceiling and roof.

Fig. 4—Test equipment attached to chimney

Table 2—Performance of masonry chimneys under steady state conditions

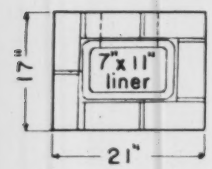
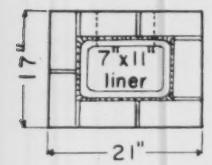
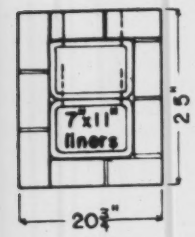
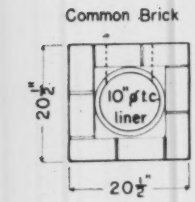
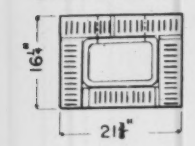
Chimney	Nominal flue-gas flow rate cfm	Observed flue-gas flow rate cfm	Observed flue-gas temp. at inlet °F	Average flue-gas temp. °F	Outside temp. °F	Draft at test conditions: Observed at chimney inlet in. W. G.	Draft at test conditions: Computed static in. W. G.	Draft at Standard conditions[a]: Observed in. W. G.	Draft at Standard conditions[a]: Computed static in. W. G.	Indicated friction loss in. W. G.	Chimney effectiveness Percent
Common Brick No. 1 15.3 ft 	20	20.3	201	131	68	0.023	0.023	0.040	0.040	0.000	63.6
	20	20.7	601	312	77	.070	.065	.090	.085	—.005	70.7
	20	21.4	999	459	57	.102	.099	.113	.110	—.003	71.9
	45	43.0	199	159	73	.028	.030	.047	.049	+.002	78.3
	45	43.6	601	410	71	.088	.085	.106	.103	—.003	83.3
	45	44.4	1000	662	77	.114	.113	.134	.133	—.001	85.2
	70	70.0	199	152	62	.029	.033	.043	.047	+.004	71.7
	70	70.9	601	473	72	.091	.094	.109	.112	+.003	85.7
	70	72.2	1000	761	57	.129	.128	.143	.142	—.001	90.9
Common Brick No. 2 15.5 ft 	20	21.3	200	127	68	.023	.022	.040	.039	—.001	65.6
	20	21.6	601	304	77	.066	.064	.087	.085	—.002	67.4
	20	21.6	995	465	57	.100	.099	.113	.112	—.001	71.9
	45	43.5	199	158	73	.028	.030	.047	.049	+.002	77.6
	45	44.0	602	396	71	.086	.084	.104	.102	—.002	80.3
	45	44.7	999	633	77	.113	.112	.133	.132	—.001	83.3
	70	70.2	199	163	62	.032	.037	.046	.051	+.005	75.4
	70	71.2	601	472	72	.091	.095	.109	.113	+.004	84.4
	70	72.4	1000	751	57	.131	.129	.144	.142	—.002	90.4
Common Brick No. 3 15.2 ft 	20	20.1	200	128	70	.021	.021	.039	.039	.000	65.0
	20	20.4	600	278	66	.063	.063	.079	.079	.000	62.6
	20	20.8	1000	421	73	.083	.086	.102	.105	+.003	65.3
	45	45.2	200	156	87	.021	.024	.045	.048	+.003	75.0
	45	45.8	601	364	72	.073	.077	.091	.095	+.004	71.3
	45	46.6	1000	572	65	.102	.108	.116	.122	+.006	74.2
	70	70.4	199	160	54	.031	.038	.042	.049	+.007	70.0
	70	71.4	601	418	64	.082	.090	.096	.104	+.008	75.5
	70	72.5	1000	662	64	.111	.118	.126	.133	+.007	80.6
Common Brick No. 4 15.3 ft 	20	20.0	199	145	70	.027	.027	.039	.039	.000	65.0
	20	20.4	600	358	66	.079	.079	.094	.094	.000	73.8
	20	20.3	1001	544	73	.107	.102	.126	.121	—.005	80.1
	45	45.2	200	173	87	.029	.029	.053	.053	.000	86.8
	45	45.8	600	434	72	.089	.088	.107	.106	—.001	84.3
	45	46.6	1000	700	65	.122	.120	.138	.136	—.002	87.8
	70	70.0	199	176	54	.038	.043	.049	.054	+.005	88.7
	70	71.0	601	481	64	.100	.100	.113	.113	.000	88.8
	70	72.1	1000	764	64	.130	.128	.145	.143	—.002	92.2
3⅝"x4"x12" Shale Multicored Tile No. 5 15.5 ft  7" x 11" liner	20	20.3	199	143	72	.026	.026	.044	.044	.000	72.2
	20	20.5	601	332	72	.072	.073	.090	.091	+.001	69.6
	20	20.9	1000	506	86	.092	.093	.117	.118	+.001	79.3
	45	45.2	199	168	81	.029	.030	.051	.052	+.001	83.6
	45	45.9	601	439	85	.085	.085	.109	.109	.000	84.4
	45	46.7	1000	695	82	.112	.114	.136	.138	+.002	85.4
	70	70.0	200	174	86	.028	.030	.052	.054	+.002	85.2
	70	71.0	601	460	81	.089	.089	.112	.112	.000	86.7
	70	72.3	1000	747	83	.117	.119	.140	.142	+.002	87.9

Table 2 *(continued)*—Performance of masonry chimneys under steady state conditions

Chimney	Nominal flue-gas flow rate cfm	Observed flue-gas flow rate cfm	Observed flue-gas temp. at inlet °F	Average flue-gas temp. °F	Outside temp. °F	Draft at test conditions: Observed at chimney inlet in. W. G.	Draft at test conditions: Computed static in. W. G.	Draft at Standard conditions[a]: Observed in. W. G.	Draft at Standard conditions[a]: Computed static in. W. G.	Indicated friction loss in. W. G.	Chimney effectiveness Percent
4"x5"x12" Fire Clay Multicored Tile No. 6 15.6 ft 16½" x 21⅛" 7" x 11" liner	20	20.1	199	142	72	.026	.026	.044	.044	.000	72.1
	20	20.5	601	324	72	.072	.071	.092	.091	—.001	70.6
	20	20.9	1000	507	86	.094	.093	.119	.118	—.001	74.2
	45	45.4	199	165	81	.028	.030	.050	.052	+.002	82.0
	45	46.0	601	436	85	.085	.085	.109	.109	.000	83.7
	45	46.6	1000	686	82	.112	.114	.136	.138	+.002	84.9
	70	70.4	200	170	86	.027	.029	.051	.053	+.002	82.2
	70	71.4	601	457	81	.089	.089	.113	.113	.000	86.8
	70	72.5	1000	741	83	.116	.118	.140	.142	+.002	87.5
4"x12"x12" Shale Tile No. 7 15.5 ft 16" x 21½" 7"x11" liner	20	20.2	199	131	69	.024	.023	.042	.041	—.001	68.8
	20	20.5	601	315	86	.071	.064	.095	.088	—.007	73.5
	20	20.9	1000	480	90	.095	.090	.112	.107	—.005	70.3
	45	45.2	199	166	87	.027	.027	.051	.051	.000	83.6
	45	45.9	601	416	89	.082	.079	.108	.105	—.003	83.6
	45	46.7	1000	648	80	.115	.115	.133	.133	.000	83.5
	70	70.3	199	163	79	.029	.030	.050	.051	+.001	82.0
	70	71.2	601	440	82	.085	.086	.108	.109	+.001	83.6
	70	72.4	1000	718	72	.119	.121	.138	.140	+.002	86.7
Common Brick No. 8 15.5 ft 16½" x 16½" 7"ø tc liner	20	20.3	199	157	55	.035	.038	.046	.049	+.003	75.4
	20	20.4	601	424	72	.085	.088	.104	.107	+.003	80.5
	20	21.0	1000	659	54	.119	.123	.130	.134	+.004	81.8
	45	45.1	199	181	67	.034	.039	.051	.056	+.005	83.6
	45	45.7	601	478	63	.093	.100	.107	.114	+.007	82.8
	45	46.6	1000	795	56	.121	.135	.133	.147	+.014	83.5
	70	70.0	199	181	73	.027	.037	.046	.056	+.010	75.4
	70	71.3	602	527	50	.093	.113	.102	.122	+.020	79.0
	70	72.4	1000	844	53	.113	.140	.124	.151	+.027	77.9
Common Brick No. 9 15.6 ft 16½" x 16½" 7"ø metal	20	20.2	199	167	55	.037	.041	.048	.052	+.004	78.7
	20	20.4	601	459	72	.093	.094	.111	.112	+.001	85.2
	20	20.8	1000	732	54	.128	.131	.139	.142	+.003	86.8
	45	45.2	199	182	67	.034	.040	.050	.056	+.006	81.8
	45	45.8	600	512	63	.094	.105	.110	.121	+.011	84.5
	45	46.6	1000	834	56	.123	.139	.135	.151	+.016	84.2
	70	70.3	199	186	73	.027	.039	.046	.058	+.012	75.4
	70	71.4	602	543	50	.094	.114	.103	.123	+.020	79.1
	70	72.3	1000	881	53	.115	.143	.126	.154	+.028	78.6
4"x8"x12" Cinder Blocks No. 10 15.5 ft 17" x 17" 7"x7" liner	20	19.9	199	140	34	.033	.042	.034	.043	+.009	55.7
	20	20.4	601	374	32	.093	.098	.093	.098	+.005	73.1
	20	21.0	1000	600	49	.114	.120	.121	.127	+.006	76.9
	45	45.2	199	170	44	.039	.047	.044	.052	+.008	72.1
	45	45.9	603	458	46	.094	.104	.101	.111	+.010	78.8
	45	46.7	999	760	50	.120	.134	.128	.142	+.014	81.4
	70	70.4	199	179	36	.039	.053	.041	.055	+.014	67.2
	70	71.3	601	492	59	.088	.101	.103	.116	+.013	81.0
	70	72.4	1000	815	71	.112	.124	.132	.144	+.012	83.9

Table 2 *(concluded)*—Performance of masonry chimneys under steady state conditions

Chimney	Nominal flue-gas flow rate cfm	Observed flue-gas flow rate cfm	Observed flue-gas temp. at inlet °F	Average flue-gas temp. °F	Outside temp. °F	Draft at test conditions: Observed at chimney inlet in. W. G.	Draft at test conditions: Computed static in. W. G.	Draft at Standard conditions[a]: Observed in. W. G.	Draft at Standard conditions[a]: Computed static in. W. G.	Indicated friction loss in. W. G.	Chimney effectiveness Per Cent
No. 11 — 15.3 ft — 4"x8"x12" Cinder Blocks — 7"x7" liner — 17" x 17"	20	20.2	199	140	34	.033	.042	.034	.043	+.009	55
	20	20.7	600	368	32	.094	.096	.094	.096	+.002	73.9
	20	20.9	1000	594	49	.113	.119	.121	.127	+.006	77.0
	45	44.8	199	176	44	.040	.048	.045	.053	+.008	73.8
	45	45.8	603	470	46	.096	.105	.102	.111	+.009	79.3
	45	46.7	999	767	50	.122	.134	.130	.142	+.012	82.7
	70	70.3	199	178	36	.039	.052	.041	.054	+.013	67.2
	70	71.1	601	498	59	.091	.101	.105	.115	+.010	82.6
	70	72.3	1000	820	71	.113	.124	.135	.146	+.011	85.9
No. 12 — 15.5 ft — 7"x11" liner — 17" x 22" — 17"x22"x8" Cinder Concrete Chimney Blocks	20	20.2	199	137	69	.023	.025	.040	.042	+.002	65.6
	20	20.5	601	325	86	.068	.066	.092	.090	—.002	71.2
	20	21.0	999	499	90	.092	.088	.121	.117	—.004	76.0
	45	45.3	199	169	87	.027	.028	.052	.053	+.001	85.2
	45	45.9	601	427	89	.081	.082	.106	.107	+.001	82.0
	45	46.7	1000	661	80	.113	.113	.135	.135	.000	84.8
	70	69.9	199	174	79	.033	.032	.055	.054	—.001	90.1
	70	70.8	601	442	82	.085	.087	.108	.110	+.002	83.6
	70	72.0	1000	711	72	.119	.121	.138	.140	+.002	86.6
No. 13 — 15.5 ft — 7"x7" liner — 16" x 16" — 16"x16"x8" Cinder Concrete Chimney Blocks	20	20.1	200	149	72	.027	.028	.045	.046	+.001	73.8
	20	20.4	601	368	59	.083	.085	.096	.098	+.002	74.3
	20	21.0	1000	574	61	.108	.112	.123	.127	+.004	77.2
	45	45.0	199	170	73	.028	.034	.047	.053	+.006	77.0
	45	45.5	601	457	67	.093	.096	.109	.112	+.003	84.4
	45	46.6	1000	727	81	.114	.118	.137	.141	+.004	86.0
	70	70.2	199	170	77	.028	.032	.047	.051	+.004	77.0
	70	71.2	601	490	79	.090	.094	.112	.116	+.004	86.7
	70	72.3	1000	790	82	.117	.123	.140	.146	+.006	87.9
No. 14 — 15.5 ft — 7"x7" liner — 16" x 16" — 16"x16"x8" Cinder Concrete Chimney Blocks	20	20.1	200	149	72	.027	.028	.045	.046	+.001	73.8
	20	20.4	601	359	59	.080	.083	.093	.096	+.003	72.0
	20	20.8	1000	552	61	.104	.109	.119	.124	+.005	74.7
	45	45.2	199	177	73	.029	.036	.048	.055	+.007	78.7
	45	45.9	601	446	67	.088	.094	.104	.110	+.006	80.5
	45	46.8	1000	714	81	.109	.116	.132	.139	+.007	82.9
	70	70.2	199	182	77	.029	.034	.051	.056	+.005	83.6
	70	71.2	601	490	79	.085	.094	.107	.116	+.009	82.8
	70	72.5	1000	786	82	.111	.122	.135	.146	+.011	84.8

[a] Standard conditions; barometric pressure 29.92 in. Hg., outdoor temperature 32° F.

Station 4. In the chimney at the roof level.

Station 5. In the chimney 6 in. below the top of the flue.

Thermocouples were also used to measure the outside air temperature and the ambient temperature inside the test structure.

The chimneys were tested in pairs with the same mass flow of gases and the same flue-gas temperature being used in both. The inlet air and gas consumption rate were regulated until the desired flue-gas temperature and volume were obtained. These conditions were then maintained for a period of 6 hr after which all observations were recorded at intervals of 15 min for a period of 1 hr.

Test Results

Chimney Draft

The principal data obtained on the 14 chimneys are summarized in Table 2. A plan view of each chimney is shown in Table 2 opposite the data obtained therefrom illustrating the materials and method of construction. This table shows the inlet and the average flue-gas temperatures, the draft observed during the test, the corrected draft for an outdoor temperature of 32 F and a barometric pressure of 29.92 in. Hg. the indicated friction loss, and the chimney effectiveness for three entering flue-gas temperatures and three rates of flue-gas flow. An examination of Table 2 shows that the draft produced by the several chimneys under steady state conditions did not differ greatly with the type of masonry material used, the type of liner used, or the treatment of the air space. However, specific pairs or groups of chimneys have been selected for comparison to

Table 3—Classification of chimneys as to masonry materials

Chimney		
Common brick	Tile	Cinder-concrete block
Specimen	Specimen	Specimen
1	5	10
2	6	11
3	7	12
4	—	13
8	—	14
9	—	—

Table 4—Classification of chimneys as to size and shape of liner

Chimney			
Rectangular 7 by 11 in. Area 77 sq in.	Round Diam 10 in. Area 78.5 sq in.	Round Diam 7 in. Area 38.5 sq in.	Square 7 by 7 in. Area 49 sq in.
Specimen	Specimen	Specimen	Specimen
1	4	8	10
2	—	9	11
3	—	—	13
5	—	—	14
6	—	—	—
7	—	—	—
12	—	—	—

show the magnitude of the differences observed.

The 14 chimneys are classified in Table 3 as to the kind of masonry units used for the chimney wall and in Table 4 as to the size and shape of the liner. If the performance of chimneys 1, 2, 5, 6, 7, and 12 using different masonry materials, but all having a 7- by 11-in. liner are compared it will be noted that the observed draft, when corrected to standard conditions, varied less than 0.01 in. W.G. at all flue-gas temperatures and volumes with one exception for the six chimneys. The variation among the drafts produced by these six chimneys was 10 percent or less except for the case of chimneys 1 and 12 when flue gases entered at a temperature of 200 F and a rate of 70 cfm. In this case, the observed draft at standard conditions was 0.043 in. W.G. for chimney 1 and 0.055 in. W.G. for chimney 12, a difference of 25 percent.

The comparison of a metal lining of enameled steel and a refractory lining in otherwise similar chimneys is afforded by specimens 8 and 9. Table 2 shows that the performances of the two chimneys were nearly identical for gas flow rates of 45 and 70 cfm, but for a flow of 20 cfm the metal-lined chimney produced slightly more draft at all three temperatures of the inlet gases. These two chimneys were tested simultaneously so that both were subjected to the same atmospheric conditions during the tests. Table 2 also shows that the indicated friction losses in the two specimens were almost equal and that the chimney effectiveness varied slightly.

The range of draft observed in the two chimneys with 7-in. round liners and the four chimneys with 7- by 7-in. square liners is shown on Figs. 5, 6, and 7. In capacity, liners of these two shapes are sometimes considered to be comparable. Fig. 5 shows that the chimneys with the round liners produced appreciably more draft than those with the square liners for a gas flow of 20 cfm. Fig. 6 shows that the performances of the two types of liners were approximately equivalent for a gas flow of 45 cfm. Fig. 7 shows that

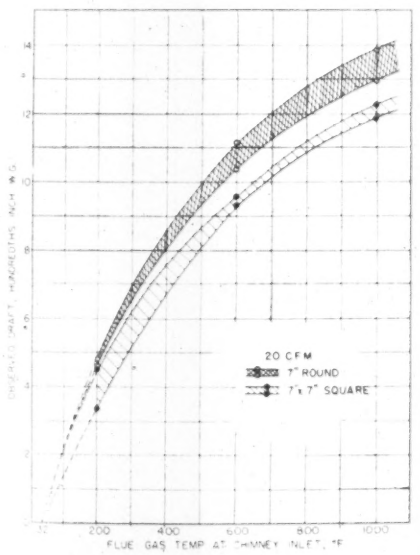


Fig. 5—Range of observed draft in round and square chimneys (20 cfm flow rate)
Outside temperature, 32 F. Barometric pressure 29.92 in. Hg.

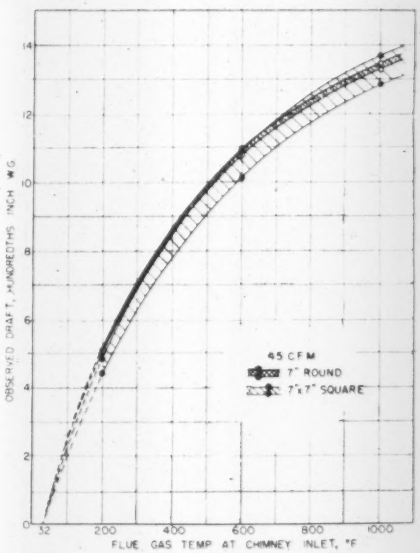


Fig. 6—Range of observed draft in round and square chimneys (45 cfm flow rate)
Outside temperature, 32 F. Barometric pressure 29.92 in. Hg.

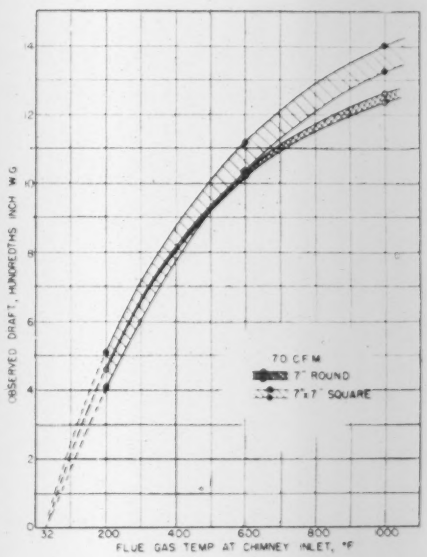


Fig. 7—Range of observed draft in round and square chimneys (70 cfm flow rate)
Outside temperature, 32 F. Barometric pressure 29.92 in. Hg.

the square liners were superior to the round liners for a gas flow of 70 cfm when the flue-gas temperature was 500 F or higher. This suggests that the two linings are not equivalent except possibly for gas flows near 45 cfm, *i.e.*, when 1 gal of fuel oil is burned with 8 percent carbon dioxide. It further suggests that the insulation used around the two circular liners may have benefited these two chimneys for low rates of gas flow, but that the greater area of the square liner more than offset the effect of the insulation at rates of flow near 70 cfm. The available draft successively increased in the square liner as the gas flow was increased from 20 to 70 cfm, whereas it decreased in the round liners as the gas flow was increased from 45 to 70 cfm.

A similar comparison is made in Figs. 8, 9, and 10, between the one chimney having a 10-in. circular liner and the six chimneys having 7- by 11-in. rectangular liners. Chimney 3 with two 7- by 11-in. liners is not included in this comparison. The 10-in. circular liner and the 7- by 11-in. liners have practically the same internal cross-sectional area. It will be noted in Figs. 8, 9, and 10 that the draft produced in the round liner was within the range of drafts observed in the six chimneys with rectangular liners for all conditions except the highest entering flue-gas temperature plotted in Fig. 8. At entering flue-gas temperatures of 1000 F, the draft observed in the round liner was equal to or exceeded the highest value observed in the 7- by 11-in. liners. The available draft increased steadily with increased gas flow in the range from 20 to 70 cfm.

The results obtained on chimney 3 with two 7- by 11-in. clay tile liners for a flue gas rate of 45 cfm are plotted on Fig. 11. Tests were made with gases entering both thimbles in the same quantity and at the same temperature and also with hot gases entering only the upper thimble while the lower thimble and corresponding liner were left open. Fig. 11 shows that from 0.005 to 0.017 in. W.G. less draft was produced by the liner served by the upper thimble when the other liner was open than when both liners were carrying hot gases. This decrease in draft amounted to 10 to 15 percent of the total available draft. The back liner, served by the lower thimble, produced more draft than the other liner presumably because it was greater in length by 1 ft. A comparison of the drafts shown in Table 2 for chimneys 1, 2, 5, 6, 7, and 12 having single 7- by 11-in. liners with the drafts shown on Fig. 11 for the front liner in chimney 3, when both liners in that chimney were supplied with hot flue gases, shows that most of the other chimneys produced a little more draft than did the comparable liner in chimney 3. These differences ranged from 0.000 to 0.006 in. W.G.

Chimney 1 was tested with the base of the chimney below the thimble sealed off and with the base open for comparison. A flue-gas rate of 70 cfm was used for these tests. The maximum difference in available draft observed for any flue-gas temperature was 0.004 in. W.G. or about 3 percent. This variation was considered small and probably of the same order as the experimental error for the test method used. Openings in the masonry wall and lining of the chimney near the base with an area of one percent of the interior chimney area made no observable difference in the available draft produced by the chimney with the base open. Undoubtedly, large openings or cracks in the masonry and lining would lower the draft and in such

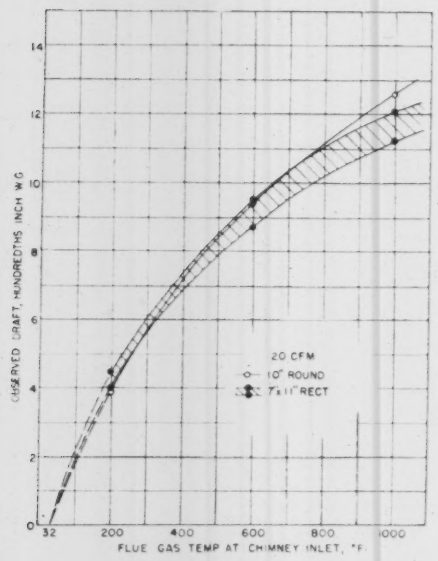


Fig. 8—Range of observed draft in round and rectangular chimneys (20 cfm flow rate)
Outside temperature, 32 F. Barometric pressure 29.92 in. Hg.

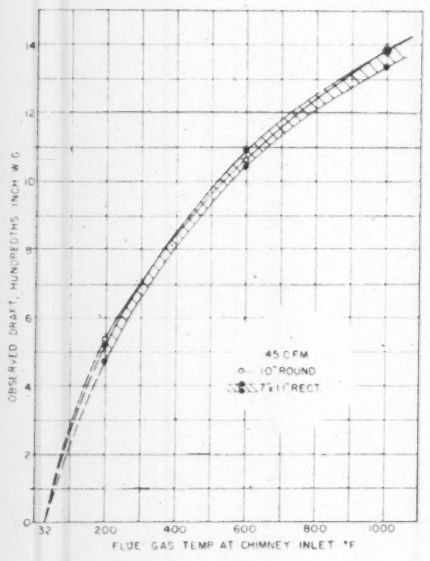


Fig. 9—Range of observed draft in round and rectangular chimneys (45 cfm flow rate)
Outside temperature, 32 F. Barometric pressure 29.92 in. Hg.

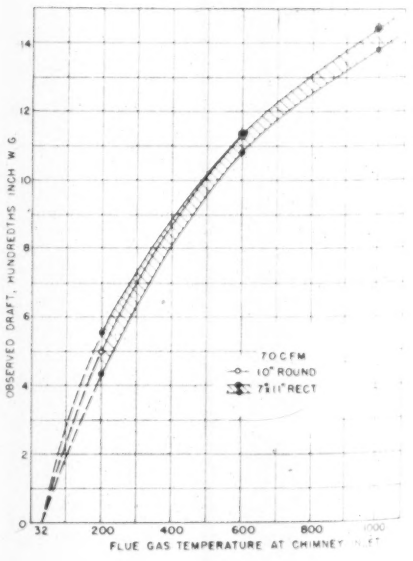


Fig. 10—Range of observed draft in round and rectangular chimneys (70 cfm flow rate)
Outside temperature, 32 F. Barometric pressure 29.92 in. Hg.

cases sealing the base would improve the performance of an existing chimney.

Comparisons of the performance of chimneys with the linings grouted in solid with those having only the liner joints grouted are provided by chimneys 1 and 2 and chimneys 13 and 14. In each of these pairs, the chimneys were of identical construction and material except for the treatment of the air space. A comparison of the data for chimneys 1 and 2 in Table 2 shows almost identical performance. The maximum difference in draft for the two chimneys was 0.004 in. W.G. with a flue-gas volume of 20 cfm and an entering temperature of 600 F.

The drafts observed in chimney 13 exceeded those in chimney 14 by amounts ranging from 0.002 in. to 0.005 in. W.G., for flue-gas temperatures from 600 F to 1000 F. This is the opposite effect from that expected if the open air space had any appreciable insulating effect.

The data in Table 2 show that the average flue-gas temperature in chimney 13 with a grouted liner was higher than that in chimney 14 with an air space for entering temperatures of 600 F and 1000 F, but that the computed static draft corresponding to these temperatures did not differ by more than 0.003 in. W.G. for any test.

Either of the following conditions might be the reason for the observed equivalence of similar chimneys with and without an air space. An open air space would permit

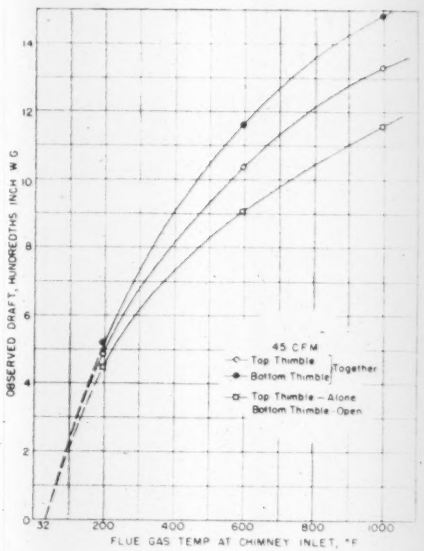


Fig. F1—Observed draft in chimney 3 (Two Flues, 7 in. x 11 in.) ***Outside temperature, 32 F. Barometric pressure 29.92 in. Hg.***

leakage of cold air through the outside masonry if there were any cracks in it, or it would permit leakage of hot gases from the liner if there were any cracks in the liner or between joints. Either kind of leakage would obviate the insulating effect of the air space. The cinder concrete blocks used in chimneys 13 and 14 appeared somewhat porous, hence, leakage through the walls themselves would also be expected in the chimney with an air space such as chimney 14.

Chimney Effectiveness

The chimney effectiveness was computed for each chimney for each different test condition, as recorded in Table 2. The chimney effectiveness is defined as the ratio of the observed draft at standard conditions to the theoretical draft that the same chimney would produce at standard atmospheric conditions with the same inlet temperature if the flue gases did not cool as they traversed the chimney. The tabulated results show that, in most instances, the effectiveness increased as the entering flue-gas temperature increased, and as the mass flow increased in the larger chimneys. In the chimneys with 7- by 11-in. liners and 10 in.-diam liner, the effectiveness increased successively as the flow rate was increased from 20 cfm to 45 cfm and from 45 cfm to 70 cfm. In the chimneys with 7- by 7-in. liners, the effectiveness increased for rates of flow up to 45 cfm but did not always increase further when a flow rate of 70 cfm was used. In both 7-in. round liners, the effectiveness was lower for a flow rate of 70 cfm than for either of the two lower flow rates.

The effectiveness ranged from a low value of 65 percent to a high value of 92 percent for the chimneys with 7- by 11-in. liners and for the one with a 10-in. round liner; the minimum and maximum values of effectiveness were 56 percent and 88 percent for the specimens with 7- by 7-in. liners; and the minimum and maximum values of effectiveness were 75 percent and 87 percent for the two chimneys with 7-in. round liners.

The friction in a chimney reduces its effectiveness because it decreases the available draft at the chimney inlet. Table 2 shows that the friction was primarily responsible for the lower effectiveness of chimneys 8 and 9 when a flow rate of 70 cfm was used, whereas the cooling of the flue gases was the important factor in the larger chimneys. In chimneys 8 and 9, the indicated friction loss reached a maximum of 18 percent of the computed static draft at standard conditions for the highest flow rate.

The friction was very small in the chimneys with 7- by 11-in. liners

Table 5—Comparison of observed draft at standard conditions for group of chimneys described in this report with two brick chimneys previously tested

Liner, 7 by 7 in.			Liner, 7 by 11 in.		
Inlet flue-gas temp. F	Brick chimney previously tested in. W.G.	Brick, shale-tile, and cinder-concrete block chimneys (1, 2, 5, 6, 7, 12) in. W.G.	Inlet flue-gas temp. F	Brick chimney previously tested in. W.G.	Cinder-concrete block chimneys (10, 11, 13, 14) in. W.G.
		20 cfm			
250	0.053	0.044–.053	275	0.055	0.053–.057
400	.072	.067–.075	——	——	——
600	.086	.093–.096	600	.088	.087–.095
1000	.115	.119–.123	1000	.108	.112–.121
		70 cfm			
200	.053	.041–.051	200	.052	.043–.055
400	.079	.078–.087	——	——	——
600	.102	.103–.112	600	.102	.108–.113
1000	.127	.133–.140	1000	.131	.138–.144

and with the 10 in.-diam liner at all of the rates of flue-gas flow used. In general, the friction loss in those chimneys was so small that the computations sometimes gave positive values and at other times negative values, indicating that the experimental errors of the tests were greater than the values sought. The indicated friction loss was always a positive value for the chimneys with the 7-in.-diam liners and with the 7- by 7-in. square liners.

Discussion and Conclusions

The results obtained on those chimneys with 7- by 7-in. square liners and 7- by 11-in. rectangular liners were compared with results previously obtained at the *National Bureau of Standards* in tests on brick chimneys[1] with liners of these same two sizes, published in the 1948 issue of the HEATING, VENTILATING, AIR CONDITIONING GUIDE. The comparison is shown in Table 5. It will be noted that the observed drafts at standard conditions in the two brick chimneys tested several years ago were in the range of drafts observed in the chimneys with the same size liner during the later tests for inlet flue-gas temperatures from 200 F to about 600 F. For inlet flue-gas temperatures above 600 F the brick, shale-tile, and cinder-concrete block chimneys produced approximately 6 percent more draft at the chimney inlet.

The difference in the exposure of the two groups of chimneys may be the reason for the observed variation in performance. The later chimneys were exposed to the outside air for only about one-third of their height, as shown in Fig. 2, whereas the two previous specimens were surrounded by outdoor air for their entire height. It was observed that the average flue-gas temperature in the later group of chimneys was higher than that in the chimneys previously tested for the same inlet flue-gas temperature. These observations show that the gases were cooled more while traversing the chimneys in the earlier tests than for the specimens now under consideration.

The results of this series of tests on 14 chimneys of the same height, but with different masonry materials for the walls, different size and type of liners, and different treatments of the air space between the liner and the chimney wall, indicate the following conclusions regarding their performance under steady state conditions:

1. Lined masonry chimneys built of shale-tile or cinder-concrete blocks are the equivalent of lined brick chimneys in draft-producing ability and effectiveness.

2. A chimney with an enameled steel lining surrounded by 1 in. of granular insulating material produced slightly more draft than a refractory-lined chimney of the same internal diameter at low rates of gas flow (20 cfm) but no appreciable difference was apparent at higher gas-flow rates. The chimney friction was practically the same for the 7 in.-diam metal lining and the 7 in.-diam refractory lining when both were clean.

3. A 7-in. round flue lining is not the equivalent of a 7- by 7-in. square lining in capacity. The available draft increased successively in the 7- by 7-in. liners as the gas-flow rate was increased from 20 to 70 cfm, whereas it increased slightly in the 7-in. round liner for increasing flow from 20 to 45 cfm and decreased between 45 and 70 cfm. The friction loss was measurably greater in the 7-in. round flue linings at a gas-flow rate of 70 cfm than in the square liners.

4. A 10 in.-diam flue liner and a 7- by 11-in. rectangular liner having equal internal area produced about the same available draft, had about the same loss of draft due to friction, and had equal effectiveness under comparable conditions.

5. In a chimney containing two contiguous liners, one liner operating alone while the other was open at the bottom produced from 10 to 15 percent less draft than a chimney containing only one liner of the same size. When both liners received flue gases at the same temperature each produced a draft nearly equal to that produced by a chimney with only one liner.

6. Sealing off the air space in the base of a new well-constructed chimney at the bottom of the thimble had no important effect on the draft produced.

7. Grouting in the liner of a masonry chimney with mortar did not decrease the average flue-gas temperature in the chimney or the available draft produced.

Although information was obtained on the several specimens for only one chimney height, the results observed for chimneys made of shale-tile and cinder-concrete block were so nearly equivalent to those obtained for brick chimneys that the results for brick chimneys may be safely used for all practical applications.

[1] Observed Performance of Some Experimental Chimneys, by R. S. Dill, P. R. Achenbach, and J. T. Duck. (ASHVE TRANSACTIONS, Vol. 48, 1942. p. 351.)

Philadelphia Chapter Officers

E. H. Dafter, *(left)* president of the Philadelphia Chapter during 1947, showing M. E. Barnard, Chapter secretary, the plaque which the board of governors presented to him on his retirement

Chicago Meeting and Exposition

January 24-28, 1949

The Stevens hotel, on the lake front, will be the headquarters for the 55th Annual Meeting of the ASHVE

SOCIETY MEMBERS will be welcomed to Chicago by the members of the Illinois Chapter during the fourth week of January 1949, when the Society's 55th Annual Meeting will be held at the Stevens Hotel.

Five technical sessions have been planned by the Program and Papers Committee starting on Monday morning, January 24. Pres. G. L. Tuve, Cleveland, Ohio, will open the meeting and among the subjects to be discussed at the Technical Sessions are: fuels and industrial ventilation, air distribution, radiant heating and environmental conditions.

The Committee on Arrangements of the Illinois Chapter is arranging for a get-together luncheon on the opening day of the meeting, and there will be special events for the ladies during the four days of the meeting.

During the same week, January 24-28, 1949, the 9th International Heating and Ventilating Exposition will be held at the International Amphitheater, Chicago, and over 300 exhibitors have reserved space. Members of the Society and exhibitors have received, through the mail, special hotel reservation forms and it is suggested that requests for rooms be filed promptly with one of the cooperating hotels. An adequate number of rooms have been reserved through the Chicago Convention Bureau.

All events during the week will be carried out under the direction of the Committee on Arrangements, which consists of the following members: W. A. Kuechenberg, *general chairman;* J. H. Milliken, *vice chairman;* M. J. Bamond and H. G. Chapin, *banquet;* J. S. Kearney, *entertainment;* G. W. Bornquist, *exposition;* P. J. Marschall, finance; O. J. Prentice, *publicity;* M. W. Bishop, *reception;* and G. V. Zintel, *sessions.*

HOTEL RATES
Rooms with Bath

Downtown Hotels	*Single*	*Double*	*Twin*	*Suite*
Atlantic	$3.50-4.50	$5.50-6.00	$8.00	
Bismarck	6.00-7.00	8.50-10.50	10.00-12.00	
Blackstone	4.00-9.00	9.00-15.00		12.50-35.00
Brevoort		5.00-6.00	6.00-7.00	
Chicagoan	2.75	4.00		
Congress	4.00	6.00		
Harrison	4.00	5.50	7.00	
La Salle	4.50-7.50	6.00-9.50	9.00-12.00	8.75-32.00
Midland	3.50-4.00	6.00	7.00	
Morrison	4.50-8.00	6.50-8.50	8.00-12.00	15.00-75.00
Palmer House	4.00 up	8.00-12.50	9.00-16.00	20.00 up
Planters		6.50	7.00	
Sherman	3.95	5.95		
The Stevens	4.50-10.00	7.50-12.50	8.50-15.00	18.00-90.00
Northside Hotels				
Allerton	$3.75	$6.50	$6.50	$12.00
Ambassador (East)	8.20		11.50	17.50 up
Ambassador (West)	7.70		10.50	16.00 up
Knickerbocker	5.00-7.00	8.00-10.00	8.00-10.00	12.00-24.00
Maryland	4.00	7.00		
Parkway	4.00-5.00		5.00-6.00	10.00-15.00
Plaza	2.75-4.00	3.75-5.00		
St. Clair	6.00	8.00	10.00	14.00 up
Wacker	1.75	2.50		
Southside Hotels				
Sherry		$8.00		$8.00-20.00
Shoreland			$9.00	14.00-20.00

1949 NOMINATIONS

Officers and Council

The Nominating Committee selected in accordance with the provisions of **Article B-VIII**—*Section 11* of the By-Laws, has submitted its selection of nominees for Officers and members of Council in 1949, as follows:

For President

ALFRED E. STACEY, JR., Syracuse, N. Y.

For First Vice President

LESTER T. AVERY, Cleveland, Ohio

For Second Vice President

LAUREN E. SEELEY, Durham, N. H.

For Treasurer

ERNEST SZEKELY, Milwaukee, Wis.

For Members of Council—*Three-Year Term*

SPENCER W. BOYD, Atlanta, Ga.
C. ROLLINS GARDNER, Dallas, Tex.
J. DONALD KROEKER, Portland, Ore.
CHARLES O. MACKEY, Ithaca, N. Y.

Respectfully submitted,

NOMINATING COMMITTEE

J. E. HAINES, *Chairman* R. H. CARPENTER, *Vice Chairman*
F. C. MCINTOSH, *Secretary*

C. M. ASHLEY, JOHN JAMES, ART THEOBALD
LEO GARNEAU, G. W. F. MYERS, W. M. WALLACE, II
G. B. SUPPLE

Alternates

H. KING MCCAIN, D. M. MILLS.

In accordance with the provisions of the Society's Constitution, By-Laws, and Rules, ballots containing the names of the above candidates will be sent to the membership for voting upon prior to the Annual Meeting in January.

Article B-IX—*Section 1.* Twenty (20) or more members of the Society, eligible to vote, may present to the Secretary, over their signatures, the name of any member eligible to hold office in the Society as a candidate for any office, provided such name is presented at least sixty (60) days preceding the next Annual Meeting, together with the written consent of the nominee to fill the office for which he has been selected, and the Secretary shall place such names on the ballot, with special notation that they are presented by members independent of the Nominating Committee report. Any member nominated for any office may withdraw his name as a candidate, whether nominated by the regular Nominating Committee or by twenty (20) or more members, providing he does so at least forty-five (45) days prior to the next Annual Meeting.

Article B-IX—*Section 2.* The secretary shall prepare ballots with the names of all candidates and forward them to the members eligible to vote, at least twenty (20) days and not more than forty (40) days before the date of the Annual Meeting.

Members of Committee on Research

Although committees of the Society are usually appointed, in view of the great importance of the Committee on Research and the responsibility it would be called upon to assume, it has been made more representative of the entire membership of the Society by a process of *election*. The election is governed by the By-Laws for the election of officers, with the single exception that Members of the Committee on Research are nominated by the Council instead of by a Nominating Committee.

In accordance with the Provisions of **Article B-VIII**—*Section 9*, the Council announces the nomination of the following members of the Committee for election to succeed those members whose present terms expire January, 1949.

Committee on Research—*Three-Year Term*

IRWIN W. COTTON, Indianapolis, Ind.
NATHANIEL GLICKMAN, Chicago, Ill.
WALTER A. GRANT, Syracuse, N. Y.
L. N. HUNTER, Johnstown, Pa.
R. D. MADISON, Buffalo, N. Y.

Two-Year Term (Unexpired Term)

E. R. QUEER, State College, Pa.

The regulations governing the nomination and election of members of the Committee on Research are as follows:

Article B-VIII—*Section 9.* COMMITTEE ON RESEARCH—The Committee on Research shall consist of fifteen (15) members and shall function in accordance with the Regulations governing the Committee on Research. The Council shall nominate, previous to July first of each year, five (5) members of the Society, to serve for three (3) years, to replace the five (5) members, whose terms expire at the close of the Annual Meeting of the Society following such nomination. The Council shall designate the nominees by letter-ballot, and the Secretary shall publish the names of the candidates nominated in the October issue of the JOURNAL.

REGULATIONS GOVERNING THE COMMITTEE ON RESEARCH

Article II—*Section 1*

(c) Any ten (10) members of the Society eligible to vote may present to the Secretary over their signatures, the name of one (1) or more additional nominees for the Committee on Research, provided such name or names are presented at least sixty (60) days prior to the next Annual Meeting, and such additional nominations shall be placed on the ballot opposite the nominations made by the Council.

(d) The election shall otherwise conform to the regulations provided for the election of officers of the Society in the Constitution, By-Laws and Rules.

(e) Vacancies may be filled by the Council, such persons chosen by the Council to serve until a successor is elected at the next Annual Meeting.

NOMINEES for 1949 OFFICERS

For President—Alfred E. Stacey, Jr., process consultant of Carrier Corp., Syracuse, N. Y. since 1946, was born on March 10, 1885 at Elbridge, N. Y. He received his preparatory education at the Munroe Collegiate Institute and obtained his M.E. degree from Syracuse University in 1906.

Following his graduation from the University he was employed as an engineer by the Buffalo Forge Co., Buffalo, N. Y., and in 1908 he joined

A. E. Stacey, Jr.
Syracuse, N. Y.

the staff of the Carrier Air Conditioning Co., in New York, as chief engineer. In 1909 he was appointed secretary and shop manager of the Elbridge Chair Co., Elbridge, N. Y., becoming its vice president in 1911. Later that year he returned to Carrier Air Conditioning Co., as Western Manager with offices in Chicago, Ill. In May, 1919 he became chief of research at Carrier Engineering Corp., Newark, N. J. In 1928 he became vice president in charge of research and in 1931 was appointed vice president in charge of engineering. He served as vice president and technical sales advisor for the corporation in 1934 and 1935.

In December 1935 with A. C. Buensod he organized the firm of Buensod-Stacey Air Conditioning, Inc., New York, and served as vice president until he entered the Navy for active service in 1941.

As Captain on the aircraft carrier *Lexington* he received the commendation of the Commander-in-Chief of the Pacific Fleet. During his Naval service, Mr. Stacey made contributions to the improvement and design of naval vessels of such importance that the military effectiveness of certain classes of vessels, including submarines in particular, was materially increased.

Mr. Stacey joined the ASHVE in 1914 when he was located in Chicago and became affiliated with the Illinois Chapter serving as Secretary from 1916 to 1919. Since that time he has taken an active part in the activities of the New York Chapter. He has served on the Society's Council, as chairman of its Finance Committee, a member of the special committee on Business and Financial Policies as well as a member of the Committee on Research for many years, and as its Chairman in 1940-41. He has also served as chairman and as a member of many code committees and Research Technical Advisory Committees. He is chairman of the Program and Papers Committee and a member of the Society's Executive Committee and the Army Liaison Committee.

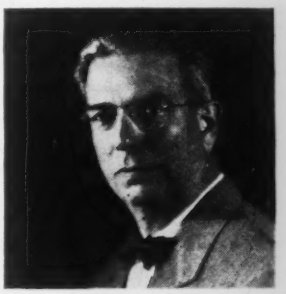
At the 52nd Annual Meeting of the Society in January, 1946, Mr. Stacey was awarded the F. Paul Anderson Gold Medal for his outstanding contributions to the advancement of heating, ventilating and air conditioning.

He is the author of numerous papers and reports in scientific journals in the chemical, ceramic, and textile engineering fields.

Mr. Stacey is a member of the *American Institute of Physics, American Society of Naval Engineers, American Institute of New York, American Society for Testing Materials, American Association for the Advancement of Science* and the *Acoustical Society of America*, as well as the Delta Upsilon Fraternity. He is listed in *Who's Who in America* and *Who's Who in Engineering*.

For First Vice President—Lester T. Avery, Cleveland, Ohio, president of the Avery Engineering Co., was born in Painesville, Ohio, on August 28, 1896. He attended Shaw High School, Cleveland, and was graduated in 1918 from the Case School of Applied Science, now known as Case Institute of Technology, with a B.S. degree.

Mr. Avery started in the refrigeration business as an engineer for the Hibbard Co., Cleveland, in 1920,



L. T. Avery
Cleveland, Ohio

and in 1921 was appointed district manager in Cleveland for the American Carbonic Machinery Co. In 1928 he was transferred to Chicago as district manager for the same company and returned to Cleveland in 1929 to start the Avery Engineering Co.

Some of the important projects which have been handled by the firm under Mr. Avery's direction are the Ben Venue Laboratories, Bedford; Ohio Bell Telephone Co., Cleveland, Columbus, Dayton, and Toledo; the Warner and Swasey Co., Cleveland; Columbus and Southern Ohio Electric Co.; Columbus Metropolitan Bank and City Loan and Savings Co., Lima; the Container Co., division of Continental Can Corp., Van Wert; Firestone Tire and Rubber Co., Akron; and the Hoover Co., North Canton.

A member of the ASHVE since 1934, Mr. Avery has been active in the affairs of the Society, as well as in the activities of the Northern

Ohio Chapter. He is currently serving as a member of the Executive and Finance Committees of the Council, as well as a member of the Army Liaison Committee, and chairman of the Society's Publication Policy Committee. He previously served a three-year term on the Council, serving as a member of the Meetings Committee for these three years, and as its chairman in 1946. Mr. Avery has also served on the Technical Papers Committee, and as chairman of the Constitution and By-Laws Committee in 1943. He was a member of the Research Finance Committee in 1939 and served as a member of the Technical Advisory Committees on Air Conditioning in Industry, and on Air Conditioning Requirements of Glass. In 1940 he served as general chairman of the Committee on Arrangements for the 53rd Annual Meeting in Cleveland.

He was elected president of the Northern Ohio Chapter during the 1936-1937 season, and served as a member of its board of governors the following year. As an active member of the Chapter he served on many of its local committees.

Mr. Avery has written many technical articles which have been published in *Heating, Piping & Air Conditioning, Refrigerating Engineering, Heating and Ventilating* and other publications.

In addition to being a member of the Society, Mr. Avery is a member of the *American Society of Refrigerating Engineers*, the *Cleveland Engineering Society* (Board of Trustees, 1945-47), the Cleveland Rotary Club, the Cleveland Chamber of Commerce, the Case Alumni Council, and the Hermit Club. He is a member of Beta Theta Pi, national fraternity.

•

For Second Vice President—Lauren E. Seeley, Durham, N. H., Dean of the College of Technology, University of New Hampshire, was born on November 8, 1898 at Meriden, Conn. He attended Yale University from which he received his Ph.B. degree in 1921, his M.E. in 1924 and his LL.B. in 1935.

While preparing for his degrees he taught courses in mechanical engineering at Yale and in 1925 was put in charge of a course in heating and ventilating, remaining at the University until 1945 when he was

L. E. Seeley
Durham, N. H.

appointed to his present position at the University of New Hampshire.

During the war, Dean Seeley served as regional advisor in Connecticut and Rhode Island for the engineering, science and management war training program of the U. S. Office of Education and was special consultant to the OPA on fuel oil and coal rationing problems. He also served as consultant on engineering and manpower problems for a number of government agencies, trade associations and private firms.

Dean Seeley is the author of numerous technical codes and papers which have been published in the Society's JOURNAL and TRANSACTIONS. His research work has been concerned chiefly with heating and ventilating, including studies of wood burning devices and the effect of relative humidity on the respiratory system.

A member of the Society since 1930 he has had an active interest in its activities and in the affairs of the Connecticut Chapter since it was organized in 1940. He served a three-year term on the Council from 1944 and during this time served on several Council Committees, such as the Executive, Finance and Standards. He also served a three-year term as a member of the Publication Committee, serving as its chairman in 1946. He is ex-officio member of the 1948 Executive and Finance Committees of the Council. Greatly interested in research, he served as a member of a number of the Research Technical Advisory Committees. He was elected president of the Connecticut Chapter during the 1940-41 season and following his term of office he served as a member of its board of governors. In 1947 he was elected Treasurer of the Society.

Dean Seeley is also a member of the *American Society of Mechanical Engineers* and of the Sigma Xi fraternity.

•

For Treasurer—Ernest Szekely, president, Bayley Blower Co., Milwaukee, Wis., was born July 24, 1888 and graduated in 1910 from the University of Budapest with an M.E. degree.

Following his graduation he spent two years at the University as assistant professor of thermodynamics, heating and ventilating, and in 1912 he became associated with Jeffrey Mfg. Co. and Guarantee Construction Co., New York, where he designed elevating systems and did general engineering work. In 1914 he joined the staff of the American Blower Co. at Detroit, as research engineer in heating and ventilating.

Ernest Szekely
Milwaukee, Wis.

Mr. Szekely joined the Society in 1920 and has been active in both the Northern Ohio and Wisconsin Chapters, as well as in Society ac-

tivities. He has served as a member of the Council, 1945 to 1947, and on many Society committees, including the Nominating, Code Committee for Exhaust Systems, and the Technical Advisory Committees on Infiltration in Buildings, Effect of Entering Temperature and Velocity on the Temperature and Distribution of Air Within an Enclosure, serving as its chairman in 1936, and as chairman of the Committee on Air Distribution in 1937. He was also a member of the Fan Test Code Committee and the TAC on Air Distribution and Air Friction, serving as its chairman for a year.

He served the Northern Ohio Chapter as its vice president and president in 1923 and 1924, and the Wisconsin Chapter as second vice president, first vice president and president in 1933, 1934 and 1935, consecutively, and as a member of its Board of Governors from 193(to 1938. Mr. Szekely also served on many code and other committees of the Wisconsin Chapter.

Mr. Szekely has published engineering articles in the technical field and is among those listed in *Who's Who in Engineering*. He is also a member of the Rotary Club.

Nominees for Members of Council

Three-Year Term

Spencer W. Boyd, Atlanta, Ga., partner in Newcomb and Boyd, consulting engineers, was born on October 4, 1904, in Atlanta. He received his B.S. in Electrical Engineering from Georgia School of Technology in 1926 and then became a test engineer with the Gen-

S. W. Boyd
Atlanta, Ga.

eral Electric Co., Schenectady, N. Y. In 1928 he joined R. S. Newcomb, Atlanta, where he was engaged in ventilating, heating, and electrical design work, and three years later became a partner in the firm. During the recent war he spent two years in active service as a lieutenant in the U.S.N.R.

As a consulting engineer, he has been responsible for the preparation of plans and specifications covering the mechanical and electrical installation for projects totalling approximately $80,000,000.00 which include in excess of 6000 tons of refrigeration for air conditioning installations.

Mr. Boyd first joined the Society in 1931. He was vice president of the Atlanta Chapter in 1938, president in 1939 and served as chairman of the Codes Committee for two years.

Mr. Boyd is also a member of the *American Institute of Electrical Engineers*, the *Georgia Society of Professional Engineers* as well as a member of the Atlanta Building Code Committee, Atlanta Building Code Advisory Board, Tau Beta Pi, and Phi Kappa Phi.

•

C. Rollins Gardner, Dallas, Tex., vice president, Martyn Brothers, Inc., was born in Denison, Tex., on May 5, 1899. He attended Texas A. & M. and his schooling was interrupted by service in the Navy.

In 1919 he became an estimator with Montrief & Montrief, mechanical contractors, Fort Worth, remaining with this firm until 1922 when he joined Martyn Brothers, Inc. He was appointed secretary of the company upon its incorporation in 1928, and in 1936 became vice president.

Mr. Gardner joined the Society in 1937 as an associate member and was elected a member in 1946. One of the charter members of the North Texas Chapter, he has served the chapter as a member of the board of governors, as secretary, treasurer, vice president and as president in 1947. He served as chapter delegate in 1946 and 1947 and served on numerous chapter committees. He is currently chairman of Chapter Delegates and General Chairman of the Committee on Arrangements for the 1950

C. R. Gardner
Dallas, Tex.

Annual Meeting and Exposition scheduled for Dallas.

Besides being a member of the Society, Mr. Gardner belongs to the Dallas Rotary Club and the Technical Club of Dallas.

•

J. Donald Kroeker, consulting engineer, Portland, Ore., was born on April 4, 1900, in Russia. He attended high schools in Saskatchewan, Canada, and Dallas, Ore. and received his B.S. in chemical engineering from the Oregon State College in 1927, and his M.E. in 1937.

Following graduation, he joined the staff of the AGA Testing Laboratory, Cleveland, Ohio, where he did research and tested gas heating appliances. In 1930 he was affiliated with the Pennsylvania Furnace and Iron Co., Warren, Pa., as development engineer, remaining with this firm until 1935, when he became associated with the Klamath Ma-

J. D. Kroeker
Portland, Ore.

chine & Locomotive Works, Klamath Falls, Ore. and later the Columbia Engineering Co., Portland. In 1938 he established his present consulting engineering offices, in Portland, specializing in heating, ventilating, air conditioning and power plant engineering.

During the last war he served as captain in the Armed Forces being promoted to major in the Corps of Engineers, U. S. Army, stationed in Alaska.

Mr. Kroeker joined the Society in 1936 and is now serving on the Chapter Relations Committee. In 1941, 1942 and 1946 he was on the Nominating Committee of the Society, the TAC on Weather Design in 1945, and on the F. Paul Anderson Award Committee. An active member of the Oregon Chapter, he served as its first president in 1939, on the board of governors from 1940 to 1943 and on numerous chapter committees.

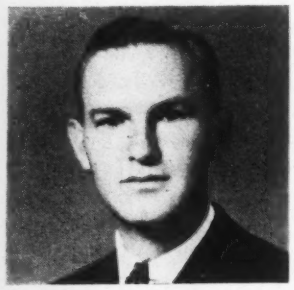
He has published various articles in technical journals and presented papers to the Society on Summer Weather Design in 1941 and A Heat Pump in an Office Building in 1948.

In addition to being a member of the Society, Mr. Kroeker belongs to the *Society of American Military Engineers*, Tau Beta Pi, Phi Kappa Phi, Sigma Tau and Sigma Delta Chi, and the Rotary Club.

•

Charles O. Mackey, Ithaca, N. Y., professor of Heat-Power Engineering at Cornell University, was born in Ithaca on October 8, 1903. He received his M.E. in 1926 from Cornell and in the following year became an instructor in experimental engineering at the university. Later, he became instructor in heat-power engineering, in 1929 an assistant professor, and in 1936 a full professor in Heat-Power Engineering. He is in charge of the Mechanical Engineering Laboratory at the University.

Professor Mackey, who joined the Society in 1942, is a member of the Committee on Research, and is



C. O. Mackey
Ithaca, N. Y.

serving as a member of Technical Advisory Committees on Cooling Load, Heat Flow Through Glass, and Panel Heating and Cooling.

He has presented many papers before the Society, is the author of several books, including *Graphical Solutions*, *Thermodynamic Charts* and *Air Conditioning Principles*, and is co-author of many articles which have appeared in various technical publications.

He is also a member of the *American Society of Refrigerating Engineers* and the *Society for the Promotion of Engineering Education*. Professor Mackey is listed in *Who's Who in Engineering*.

LABORATORY STUDIES ON ENVIRONMENTAL HEAT EXCHANGES

The rapid measurement and recording of heat exchange between the human body and its environment is being studied by the ASHVE Research Laboratory at Cleveland, Ohio, under a project being sponsored by the Naval Medical Research Institute and the Office of Naval Research.

The initial investigation is concerned with the possibility of designing, developing and constructing a calorimeter capable of holding a human subject. In addition to measuring the heat exchange of the body with its surroundings, the calorimeter must be capable of creating sudden changes in environment. Thus, observations of the heat exchange of the human body under a variety of experimental conditions can be made.

Previous research has established the mechanics by which the body maintains approximately constant internal temperatures over a wide range of environmental conditions. However, little is known about the effect of environment on the heat generated within the body. It is hoped that these studies will add materially to our understanding of the effect of environment on human metabolism.

Almost from its inception in 1919 the ASHVE Research Laboratory in cooperation with medical authorities has been investigating the effect of atmospheric environment on human beings and their sense of comfort. Since 1946 the Medical School of the University of Illinois has been conducting research sponsored by ASHVE on the *shock effect* encountered when entering or leaving a summer air conditioned space. The results of all these studies have contributed greatly to human comfort and health.

It is because of this background and experience in the field of physiological research and the consulting service available to ASHVE through its technical advisory committees that the Society has been requested to undertake the Navy program.

J. W. MAY IN NEW POST

James W. May is now technical director of the Air Filter Division, American Air Filter Co. Inc., Louisville, Ky.

Before joining American Air Filter Co. as director of research in 1943, Mr. May was associate professor of heating, ventilating and air conditioning at the College of Engineering, University of Kentucky. While there, he conducted research projects in heating, ventilation and air filtration, and handled special assignments in the American Air Filter laboratory.

Mr. May is a member of *Sigma Xi*, the *Kentucky Society of Professional Engineers* and the Technical Advisory Committee on Air Cleaning of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.

EXHAUST ARRANGEMENT FOR DOUBLE-ENDED TENNONER,

BY K. L. Whitaker, ASHVE

Of all the modern wood working machines the double ended tennoner presents one of the most complicated exhaust problems. This machine cuts, simultaneously, tennons at both ends of a length of timber. The timber enters the machine on a conveyor at one side and is carried through the cutters to the other side where it is removed in finished form.

Each end of the timber requires four rotary cutters and one cut-off saw to accomplish the operation. This makes a total of eight chip exhaust points and two saw-dust exhaust points on the whole machine.

The rotary cutters and the saw are adjustable for depth of cut so that all ten exhaust hoods have a movement of about 8 in. in one direction or another, and the exhaust pipes must be capable of taking up this movement. Furthermore, the machine must accommodate varying lengths of timber from approximately 6 in. to 8 ft 6 in., and to do this one side of the machine, complete with its four cutters, saw and conveyor, is mounted on a movable carriage, moved by power, to suit the required length of timber.

The main problem for the engineer is to design an exhaust system which will not only permit 8 in. movement on each of the 10 hoods, but on five of the hoods will permit an additional movement of 8 ft 6 in.

The problem was approached on the basis that an overhead system was preferable and therefore the smaller hood adjustment could be taken up by means of flexible metallic connections. These connections take up both horizontal and vertical movement, but due to height restrictions, it was necessary to allow for a vertical telescopic joint between the hood and each flexible connection. This joint could also be utilized for quick removal of the exhaust connection to give access to the hood and cutters.

After considering various ways of dealing with the 8 ft 6 in. movement it was decided to utilize a horizontal telescopic pipe, and to enable this to function satisfactorily, ball bearing runners were designed together with an air seal to enable the expansion joint to operate with a minimum of effort. Since the main pipe was 13 in. in diameter, it was obvious that an ordinary telescopic joint would bind and would not be satisfactory.

The next problem was to support the overhead piping over the movable carriage so that the telescopic pipe would adjust itself automatically as the carriage was moved under its own power. Due to the very compact layout of the machine it was only found possible to provide two vertical steel supports, but it was found that these, together with suitable cross bracing, when bolted up together with the overhead piping, formed a satisfactory rigid arrangement.

Fig. 1 shows the completed installation, which has proved itself in practice. The movable carriage is on the right of the photograph, and the ball bearing expansion joint is in the main pipe connecting to this side of the machine.

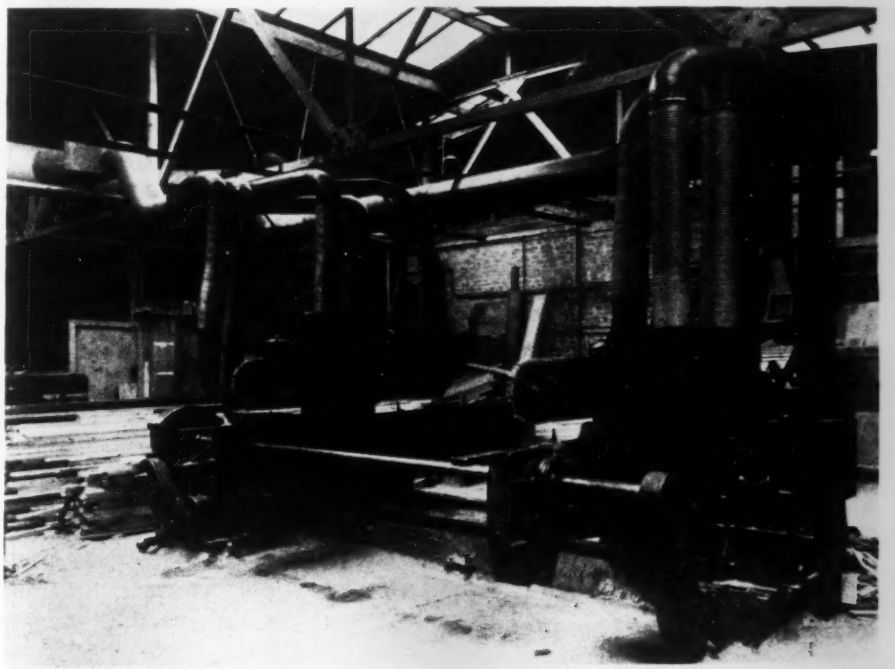


Fig. 1—Adjustable Exhaust System for Double Ended Tennoner

Summary of Local Chapter Meetings*

Cincinnati—May 27, 1948. After reports by the various committee chairmen, elections for the coming year were held and the following officers were elected: *President*—M. E. Mathewson; *Vice President*—K. B. Little; *Secretary-Treasurer*—E. W. McNamee; *Board of Governors*—D. J. Wood. H. E. Sproull discussed the possibility of establishing a student branch at the University of Cincinnati, which was thought to be an excellent idea and further work will be done along these lines. He then presented a Past President's pin to H. K. Jennings, who was given a rising vote of thanks by the members. Attendance 65.

•

North Texas—July 19, 1948. The meeting, in the form of a picnic, was held at Vickery Park. G. A. Linskie, vice president, presided, although no official business was transacted. A chicken dinner was enjoyed by all. Attendance 46.

•

Shreveport—June 17, 1948. G. C. Kerr, New Orleans, La., past president of the Delta Chapter, was the guest speaker. He gave a talk and presented a movie on the subjects, Sound Waves and Their Sources, and the Fundamentals of Acoustics. S. W. Beaty was appointed chairman of the Publicity Committee.

•

Shreveport—July 22, 1948. After giving a few highlights of the Semi-Annual Meeting at Bretton Woods, Reg. F. Taylor introduced H. L. DeVines, Houston, Tex., who gave his paper and demonstration on the Use of Atomic Energy in Air Conditioning. The Meeting Committee announced the prospective list of speakers for the fall meetings and it was reported by the Membership Committee that approximately 55 members were now signed up with the Shreveport Chapter. Attendance 39.

•

South Texas—June 25, 1948. The annual picnic of the South Texas Chapter was held at Milby Park, Houston, Tex. Approximately 40 members of the Chapter and their families attended, participating in sack races, softball games, horseshoe pitching and other sports. Picnic lunches were pooled into a buffet supper and soft drinks were served by the Chapter.

•

Southwest Texas—August 19, 1948. H. E. Degler, Marley Co., Kansas City, Kan., presented a talk on design and performance of water cooling towers. The talk covered many phases of water cooling problems and its economics, and was followed by an interesting discussion. After appointing chairmen for the standing committees, Pres. G. R. Rhine opened discussion on a meeting to be held in the fall on the order of a one day meeting. It was planned to hold technical sessions in the afternoon followed by a dinner at night after which additional papers might be presented. Out of town guests will be invited, and possibly entertainment planned for the ladies. R. W. Kotzebue was elected program chairman for this meeting. A new Board of Governors was elected as follows: G. R. Rhine, F. C. Benham, Jr., Allen Henry, P. E. Locker, R. J. Bernhardt, A. J. Rummel and R. W. Barnes. Attendance 29.

•

Utah—May 14, 1948. Officers elected for the coming year are *President*—E. J. Watts; *Vice President*—C. E. Ferguson; *Secretary*—R. H. East. G. A. Voorhees, application engineer for the *National Warm Air Heating and Air Conditioning Association* spoke. He outlined the changes that have been made in the warm air heating code and described a number of new warm air heating applications and the numerous problems involved. It was with a deep sense of loss that the members marked the passing on May 3, of Henry G. Richardson, first president of the Utah Chapter. He will be missed at the Chapter meetings which he attended regularly. Attendance, 23. Attendance ratio, 0.30.

* Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

M. R. HAMLIN DIES AS RESULT OF ACCIDENT

Millard R. Hamlin, Columbus, Ohio, heating and ventilating engineer, died on August 11 as a result of injuries received in an auto accident on August 4. He had been manufacturer's representative for a number of engineering firms.

Born in Akron, Ohio, in 1900, Mr. Hamlin was graduated with a B.S. in mechanical engineering from Case Institute of Technology. In 1921 he was with the White Motor Co., Cleveland, later with Brown-Graves Co., and the Goodyear Tire and Rubber Co., Akron. Recently he was with A. L. Vanderhoof, Inc. and Feldman Brothers Co. of Cleveland.

Besides being a member of the ASHVE, Mr. Hamlin belonged to the Kiwanis Club, University Club, the American Legion, Sigma Nu frater-

nity, and was an honorary member of Tau Beta Pi.

His wife, Angela Hamlin, and two daughters, Mary and Angela survive.

M. F. MATTINGLY DROWNED

Maurice F. Mattingly, Elmwood Park, Ill., drowned on August 5, 1948, in Monument Lake, Trinidad, Colo., while fishing from a boat with his uncle, J. L. Poutra, Houston, Tex. Both men were thrown into the water when the boat overturned while Mr. Mattingly was standing up to reel in a fish. Mr. Poutra was able to cling to the boat until rescued, but Mr. Mattingly sank before help arrived.

Mr. Mattingly was born in Champaign, Ill., on December 27, 1904. He attended St. Mary's High School in Champaign, the University High School in Urbana, and the University of Illinois, receiving his B.S. in industrial engineering in 1927. From 1927 to 1934 he was sales engineer with the Herman Nelson Corp., Moline, Ill. In 1935 he was with Minneapolis - Honeywell Regulator Co., and then for several years was on the sales staff of the International Exposition Co. Since 1939 he had been with the Johnson Service Co., in its Chicago office.

Joining the Society in 1939, he was an active member of the Illinois Chapter and will be greatly missed at Chapter meetings.

WESTERN MICHIGAN CHAPTER SECRETARY DIES SUDDENLY

Claude V. Saunders, Kalamazoo, Mich., vice president and chief engineer of Louis C. Kingscott and Associates, Inc., architects and engineers, died of a heart attack on August 9, 1948. He was secretary of the Western Michigan Chapter of the Society, having first joined the Society in 1916.

Born in Detroit, Mich., February 13, 1879, Mr. Saunders attended the Detroit Central High School and the University of Michigan. In 1900 he was associated with the U. S. Lake Survey, and later he was with American Blower Co., C. H. Witham Paper Co., Clarage Fan Co., and Warren S. Holmes Co. He served for eight years with the National Park Service, first as project supervisor and later as superintendent of the National Park Service. In 1942 he had charge of mechanical specifications for the Green River Ordnance Plant, Dixon, Ill., and the conversion of the Battle Creek Sanitorium to the Percy Jones General Hospital. Prior to joining Kingscott and Associates, he was a mechanical engineer at the Static Testing Laboratory, Wright Field, Dayton, Ohio.

He is survived by his wife, Emily, a son Norman of Chicago, and a brother, Fred, of Detroit.

W. P. WHITTINGTON, INDIANAPOLIS, DIES

William Penrose Whittington, Indianapolis, Ind., president of the Whittington Pump and Engineering Co., died on June 30.

Born in Mt. Vernon, Ohio, Mr. Whittington went to school there, later attending the Lewis Institute in Chicago. In 1918, he joined the Edison Co., first in Chicago, and later in Springfield, Ohio.

Mr. Whittington was a specialist in the design of vacuum heating equipment and systems. He joined the Society in 1928 and was an active member of the Indiana Chapter.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 54 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by October 25, 1948, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

APPLETON, HYMAN, Designer, Stone & Webster Engineering Corp. PROPOSERS: L. Conrad*, L. F. Pries*. SECONDERS: I. S. Boak*, R. C. Carter*.

BAER, D. H., Project Engineer, Utility Appliance Corp. PROPOSERS: J. B. Venneman, Richard Petersen. SECONDERS: Leo Hungerford, R. L. White*.

BEDEIN, PHILLIP, Student, University of Michigan. PROPOSERS: Axel Marin, F. N. Calhoun. SECONDERS: Daniel Grosser, Harold Lester*.

BERMAN, J. K., Student, Massachusetts Institute of Technology. PROPOSERS: L. K. Berman, R. K. Raisler. SECONDERS: James Holt, Harold Herkimer.

BLACK, JAMES, Mgr., Bennett & Wright, Ltd. PROPOSERS: D. A. Stott, J. H. Fox. SECONDERS: V. J. Jenkinson, M. W. Shears.

BOOTES, C. J., Mgr. Spec. Div., The Powers Regulator Co. of Canada, Ltd. PROPOSERS: D. A. Stott, W. E. Williams. SECONDERS: Arthur Nearingburg, J. L. Neilans.

*Non-member

BOTTS, T. R., Engr., Dan Truog & Clyde Nichols, Inc. PROPOSERS: D. M. Allen, J. S. Dukelow. SECONDERS: Carl Clegg, C. W. Schumacher.

BOWER, H. G., Mgr., F. H. Wheelers (Sheffield) Ltd. PROPOSERS: T. B. Wilson, C. V. Ward. SECONDERS: A. Walters*, R. P. Middleton*.

BROWN, S. W., Chief Engr., Marine Dept., Carrier Corp. PROPOSERS: O. W. Armspach, W. H. Driscoll. SECONDERS: A. E. Stacey, Jr., Albert Giannini.

BUSHEY, C. W., Owner, Better Bilt Equipment Co. PROPOSERS: D. S. Cooper, C. C. Quin. SECONDERS: D. M. Robinson, D. M. Mills.

COCHRAN, J. H., Sales Engr., Heaven Engineering Co. PROPOSERS: L. P. Heaven, J. A. Rhodes*. SECONDERS: C. E. Gay, Sr., R. F. Moor*.

COOPER, F. E., Precipitron Application Engr., Westinghouse Electric Corp. PROPOSERS: A. J. Boney, F. W. Jordan. SECONDERS: G. M. Simonson, I. G. Alger, Jr.

CRICHTON, G. A., Asst. Field Engr., Iron Fireman Mfg. Co. of Canada, Ltd. PROPOSERS: Malcolm Todd, W. R. Blackhall. SECONDERS: D. R. Steeves, H. S. Moore.

DANCY, F M., Application Engr., York Products Division, Modern Appliances, Inc. PROPOSERS: D. S. Sterner, R. L. Beach. SECONDERS: E. C. Harper, S. M. Roberts.

DIXON, J. M., Sales Promotion Engr., Chase Brass & Copper Co. PROPOSERS: S. R. Osborne, R. L. Maher. SECONDERS: L. P. Lanigan*, S. S. Guzzardi.

DZIRBIK, E. M., Htg. & Vent. Engr., Nash Kelvinator Corp. PROPOSERS: I. J. Haus, C. H. Amundson. SECONDERS: F. W. Goldsmith, J. A. Lofte.

EASSA, N. B., Student Engr., Carrier Corp. PROPOSERS: J. H. Carpenter, G. F. Keane. SECONDERS: F. B. Neyhart, J. F. Schmidt.

ERMAN, M. K., Sumerbank Construction Dept. PROPOSERS: N. F. Uran, Sahap Kocatopcu*. SECONDERS: Kenan Okan*, Ihson Topaloglu*.

EVANS, W. S., Archt. & Engr., Wm. S. Evans. PROPOSERS: E. J. Kearby, B. E. Segall, Jr. SECONDERS: W. E. FitzGerald, A. H. Otto.

FARRAR, B. F., JR., Student, Southern Methodist University. PROPOSERS: J. W. Lacy, R. M. Matson*. SECONDERS: D. C. Pfeiffer, Herman Blum, Jr.

GREENE, L. A., Plant Engr., A. & M. College of Texas. PROPOSERS: E. J. Kearby, B. E. Segall, Jr. SECONDERS: W. E. FitzGerald, A. H. Otto.

HAAS, L. C., Owner, Lester C. Haas. PROPOSERS: M. A. Hudson, P. O. Rottman. SECONDERS: B. E. Segall, Jr., W. E. FitzGerald.

HEARD, J. A. E., LT. COL., Sales Engr., Carrier Engineering Co., Ltd. (*Advancement*) PROPOSERS: R. V. D. Dunne, R. E. Thompson. SECONDERS: W. H. Driscoll, Albert Giannini.

HERZOG, D. M., Branch Mgr., Carrier Corp. PROPOSERS: M. E. Barnard, W. A. Borneman. SECONDERS: L. M. Church, R. H. Smiles.

HOFFMAN, L. B., Sales Engr., Hoffman & Hoffman Co. PROPOSERS: E. S. deWitt, H. B. Hoffman. SECONDERS: E. G. Embree, R. M. Warren, Jr.

HUSTED, W. G., Student, Purdue University. PROPOSERS: F. B. Morse, W. T. Miller. SECONDERS: R. G. James, J. H. Miller.

KELLER, W. D., Sales Mgr., M & R Engineering Co. PROPOSERS: T. A. Reina*, E. J. Merenda*. SECONDERS: Fred Halama*, E. C. Beutler.

KNUDSON, K. P., JR., Sales & Application Engr., O'Shea Engineering Co. PROPOSERS: J. J. O'Shea, F. A. Player. SECONDERS: W. H. Curry, J. A. Dodd.

LINDGREN, R. H., Owner, Lindgren & Lindgren Air Conditioning. PROPOSERS: R. H. Lee, H. R. Nichols. SECONDERS: K. W. Miller, L. W. Bren.

LOMBARDI, J. P., Student, Massachusetts Institute of Technology. PROPOSERS: A. L. Hesselschwerdt, Jr., James Holt. SECONDERS: Carl Sayhlor, Robert Birkins.

MATTOX, J. K., JR., Engr., Tex-Air Conditioning Co. PROPOSERS: C. S. Bauman, M. J. Murray. SECONDERS: M. W. Brown, J. A. Bishop.

McDORMAN, W. A., Lustron Corp. PROPOSERS: A. I. Brown, S. M. Marco*. SECONDERS: S. R. Beitler*, C. A. Norman*.

MINNICH, S. C., JR., Engr. & Principal of Firm, Six Associates, Inc. PROPOSERS: W. C. Price, F. E. P. Klages. SECONDERS: M. L. Hunken, W. M. Wallace, II.

MOTL, B. C., Sales Repr., Allis-Chalmers Mfg. Co. PROPOSERS: A. L. Jones, J. H. Carpenter. SECONDERS: J. E. Marris, J. F. Schmidt.

NICHOLLS, F. R., Engr., Associated London Properties, Ltd. PROPOSERS: W. E. Daniel, T. C. Elsby*. SECONDERS: J. J. Fraser, Mr. Benson*.

OLSON, W. J., Hurley Engineering Co. PROPOSERS: R. H. Liniger, R. O. Wesley. SECONDERS: C. A. Pangborn, D. O. Mead.

OLVANY, G. L., Office Mgr., William J Olvany, Inc. PROPOSERS: W. J. Olvany, E. E. Ashley. SECONDERS: W. W. Murray, Jr., J. C. Fitts.

OLVANY, W. J., JR., Vice Pres., William J. Olvany, Inc. PROPOSERS: W. J. Olvany, E. E. Ashley. SECONDERS: W. W. Murray, Jr., J. C. Fitts.

QUIN, C. C., Branch Mgr., The Powers Regulator Co. (*Advancement*). PROPOSERS: D. M. Mills, R. J. Salin[illegible]. SECONDERS: H. L. DeVines, H. W. Broadwell.

RICHARDS, E. M. Chief Engr., Co[illegible]str. Dept., McLellan Stores Co. PROPOSERS: H. J. Ryan, J. W. McGuire. SECONDERS: G. J. Sweeney, L. B. Miller.

RODRIGUEZ, G., C. A., Eng., Carrier Corp., Latin American Region. PROPOSERS: J. H. Carpenter, J. F. Schmidt. SECONDERS: G. F. Keane, F. B. Neyhart.

ROSEN, E. J., Tech. Engr., Merrill N Musgrave & Co. (*Advancement*). PROPOSERS: R. A. Brobeck, J. B. Notkin. SECONDERS: R. M. Towne, M. N Musgrave.

SCOTT, H. C., Sauer Co., Inc. PROPOSERS: Joseph Zellak, M. R. Hamlin. SECONDERS: H. R. Allonier, J. A. Gery.

STOPPELMAN, L. E., Designer, Sverdrup & Parcel, Cons. Engrs. PROPOSERS: J. W. Layton, E. P. Wood*. SECONDERS: W. W. Charlton*, W. E. Lorenz*.

SULLIVAN, W. A., Dist. Mgr., A. P. Green Fire Brick Co., Ltd. PROPOSERS: J. R. Stephenson, D. F. Michie. SECONDERS: Einar Anderson, W. H. McKay.

SWADLING, W. L., The Guy E. Murphy Co. PROPOSERS: William Dixon, B. W. Bigham. SECONDERS: E. F. Hyde, C. F. Mally.

TRIPP, G. R., Engr., Goodyear Tire & Rubber Co. PROPOSERS: E. W. Crawford*, Charles Cathan*. SECONDERS: H. R. Roth, J. W. Powlesland.

TRUOG, S. T., Vice Pres. & Gen. Mgr., Dan Truog & Clyde Nichols, Inc. PROPOSERS: D. M. Allen, J. S. Dukelow. SECONDERS: Carl Clegg, C. W. Schumacher.

VAN ZUILEN, DIRK, Dir. of Res., National Council for Applied Scientific Research. PROPOSERS: Cyril Tasker, C. M. Humphreys. SECONDERS: H. B. Nottage, G. V. Parmelee.

VARBLE, PINKNEY, Sales Engr., American Radiator & Standard Sanitary Corp. PROPOSERS: C. T. Doudican, W. C. Pistler. SECONDERS: O. W. Motz, R. F. Taggart.

WILLIAMS, R. J., Instructor, New York Technical Institute. PROPOSERS: Leo Whelan, J. W. McGuire. SECONDERS: R. W. Christie, G. J. Sweeney.

WOLKOW, BENJAMIN, Pres., Wolkow Sheet Metal Industries, Inc. PROPOSERS: R. R. Bennis, Bernard Leventhal. SECONDERS: B. E. Tiltz, George Belsky.

WYATT, G. A., Draftsman, Arthur G. Stout & Associates. PROPOSERS: A. G. Stout, J. E. Patten. SECONDERS: J. E. McClellan, N. E. Bueter.

YAEGER, L. A., Commercial Sales Mgr., Reichert Refrigeration Co. PROPOSERS: W. B. Buck, J. T. B. Hullgren. SECONDERS: C. M. Stanton*, E. H. Seelert.

Officers

President.....G. L. TUVE *Treasurer*.....L. E. SEELEY
First Vice Pres...A. E. STACEY, JR. *Secretary*.....A. V. HUTCHINSON
Second Vice Pres......L. T. AVERY *Technical Secretary*.CARL H. FLINK
Assistant to the President.....C. A. MCKEEMAN

Council

G. L. TUVE, *Chairman* A. E. STACEY, JR., *Vice Chairman*

Three Years: D. M. ALLEN, F. A. HAMLET, C. S. LEOPOLD, H. E. SPROULL.

Two Years: M. W. BISHOP, CARL F. BOESTER, LEO HUNGERFORD, R. F. TAYLOR.

One Year: E. G. CARRIER, F. W. HUTCHINSON, R. A. SHERMAN, B. M. WOODS, M. S. WUNDERLICH, L. N. HUNTER, *Ex-Officio*.

Council Committees

Executive—G. L. TUVE, *Chairman;* L. T. AVERY, A. E. STACEY, JR., L. E. SEELEY, *Ex-Officio*.

Finance—R. A. SHERMAN, *Chairman;* L. T. AVERY, C. S. LEOPOLD, L. E. SEELEY, *Ex-Officio*.

Program and Papers—A. E. STACEY, JR., *Chairman;* M. W. BISHOP, F. W. HUTCHINSON.

Membership—R. F. TAYLOR, *Chairman;* E. G. CARRIER, LEO HUNGERFORD.

Standards—M. S. WUNDERLICH, *Chairman;* D. M. ALLEN, C. F. BOESTER.

Advisory Board

Baldwin M. Woods, *Chairman;* Homer Addams, M. F. Blankin, W. H. Carrier, S. E. Dibble, S. H. Downs, W. H. Driscoll, E. O. Eastwood, W. L. Fleisher, H. P. Gant, F. E. Giesecke, E. Holt Gurney, L. A. Harding, H. M. Hart, C. V. Haynes, E. Vernon Hill, John Howatt, D. D. Kimball, G. L. Larson, S. R. Lewis, J. F. McIntire, Alfred J. Offner, F. B. Rowley, A. C. Willard and C.-E. A. Winslow.

Chapter Delegates Committee 1948

CHAPTER	DELEGATE	ALTERNATE
ATLANTA	L. L. Barnes	Leo Sudderth, Jr.
CENTRAL NEW YORK	D. L. Mills	C. O. Mackey
CENTRAL OHIO	H. R. Allonier	W. M. Myler, Jr.
CINCINNATI	H. K. Jennings	M. E. Mathewson
CONNECTICUT	S. R. Osborne	Winfield Roeder
DELTA	J. S. Burke	L. R. Maxwell
GOLDEN GATE	John Everetts, Jr.	N. H. Peterson
ILLINOIS	W. A. Kuechenberg	C. M. Burnam, Jr.
INDIANA	I. W. Cotton	G. B. Supple
IOWA	C. A. Wheeler	D. C. Murphy
KANSAS CITY	H. E. Gould	Henry Nottberg, Jr.
MANITOBA	D. S. Swain	Einar Anderson
MASSACHUSETTS	Adolph Ehrenzeller	R. T. Kern
MEMPHIS	E. E. Scott	
MICHIGAN	E. F. Hyde	
MINNESOTA	L. C. Gross	B. F. McLouth
MONTREAL	T. H. Worthington	Leo Garneau
NEBRASKA	K. R. Magarrell	K. E. Martin
NEW YORK	M. C. Giannini	A. A. Bearman
NORTH CAROLINA	E. S. deWitt	DeParx Stimson
NORTH TEXAS	C. R. Gardner	G. A. Linskie
NORTHERN OHIO	W. R. Moore	L. S. Ries
OKLAHOMA	G. T. Donceel	E. T. P. Ellingson
ONTARIO	W. W. Miller	A. J. Strain
OREGON	J. P. McDermott	B. W. Farnes
PACIFIC NORTHWEST	L. L. Bysom	J. D. Sparks
PHILADELPHIA	J. O. Kirkbride	E. K. Wagner
PITTSBURGH	B. B. Reilly	C. H. Schneider
ROCKY MOUNTAIN	H. H. Herman	D. J. McQuaid
ST. LOUIS	G. W. F. Myers	B. L. Evans
SHREVEPORT	A. H. Otto	
SOUTH TEXAS	D. M. Mills	C. C. Quin
SOUTHERN CALIFORNIA	R. A. Lowe	R. S. Farr
SOUTHWEST TEXAS	G. R. Rhine	I. W. Wilke
UTAH	C. E. Ferguson	E. V. Gritton
VIRGINIA	D. E. Phillips	
WASHINGTON, D. C.	H. H. Hill	A. S. Gates, Jr.
WESTERN MICHIGAN	H. R. Limbacher	C. H. Pesterfield
WESTERN NEW YORK	Roswell Farnham	Edwin Woolcock
WISCONSIN	F. J. Nunlist	J. R. Vernon

Special Committees

Admission and Advancement—E. R. Queer, *Chairman;* T. F. Rockwell (*two years*), L. S. Ries (*three years*).

Army Liaison—R. A. Sherman, *Chairman;* L. T. Avery, L. N. Hunter, H. King McCain, S. C. Rothman, A. E. Stacey, Jr., T. H. Urdahl.

ASHVE *Code for Testing Heavy Duty Furnaces*—E. K. Campbell, *Chairman;* Bowen Campbell, R. S. Dill, F. A. Kitchen, A. P. Kratz, W. J. MaGirl, B. F. McLouth, F. L. Meyer, F. J. Nunlist, A. A. Olson, B. B. Reilly, Dr. H. J. Rose, H. A. Soper.

Chapter Relations—D. M. Allen, *Chairman;* C. Z. Adams, C. S. Koehler, J. Donald Kroeker, C. H. Pesterfield, W. F. Ryan, D. A. Stott.

Constitution and By-Laws—S. H. Downs, *Chairman;* John James, H. E. Sproull.

Guide Publication—R. C. Cross, *Chairman;* A. B. Algren, R. L. Byers, R. P. Cook, Nathaniel Glickman, B. H. Jennings, H. R. Limbacher, W. M. Wallace, II, W. N. Witheridge, Cyril Tasker, *Ex-Officio*.

Nominating—J. E. Haines, Minneapolis, Minn., *Chairman;* R. H. Carpenter, New York, N. Y., *Vice Chairman;* F. C. McIntosh, Pittsburgh, Pa., *Secretary;* C. M. Ashley, Syracuse, N. Y., Leo Garneau, Montreal, Que., Canada; John James, Chicago, Ill.; G. W. F. Myers, St. Louis, Mo.; G. B. Supple, Indianapolis, Ind.; Art Theobald, Los Angeles, Calif.; W. M. Wallace, II, Durham, N. C. *Alternates:* H. King McCain, Atlanta, Ga., and D. M. Mills, Houston, Tex.

Publication—John James, *Chairman;* R. S. Dill, S. S. Sanford, R. D. Madison, *Ex-Officio*.

Publication Policy—L. T. Avery, *Chairman;* R. S. Dill, John James, L. N. Hunter, L. P. Saunders.

Public Relations—M. F. Blankin, *Chairman;* J. S. Locke, C. E. Price, K. C. Richmond, T. H. Urdahl, B. M. Woods.

Research Promotion—J. E. Haines, *Chairman;* W. E. Heibel, A. J. Hess, C. E. Price, D. L. Taze.

Committee on Research

ASHVE Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio (Tel.: EXpress 6161)

L. N. HUNTER, *Chairman* R. D. MADISON, *Vice Chairman*
CYRIL TASKER, *Director of Research* A. C. FIELDNER, *Ex-Officio*

Executive Committee: L. N. Hunter, *Chairman;* R. D. Madison, *Vice Chairman;* L. G. Miller, L. P. Saunders, W. E. Zieber.

Three Years: A. B. ALGREN, M. C. GIANNINI, C. W. JOHNSON, E. R. QUEER, W. E. ZIEBER.

Two Years: R. C. CROSS, M. K. FAHNESTOCK, JOHN JAMES, F. J. KURTH, T. H. URDAHL.

One Year: L. N. HUNTER, C. O. MACKEY, R. D. MADISON, L. G. MILLER, L. P. SAUNDERS.

Technical Advisory Committees 1948

Air Cleaning: R. S. Dill, *Chairman;* L. L. Dollinger, Jr., O. C. Eliason; R. S. Farr, C. D. Graham, A. B. Hubbard, R. E. Hunsaker, D. L. Hunzicker, J. W. May, K. W. MacKenzie, R. H. Mills, G. W. Penney, L. P. Saunders*, R. P. Warren, R. D. Wood.

Air Distribution: Ernest Szekely, *Chairman;* N. E. Berry, R. M. Conner, S. H. Downs, F. B. Holgate, F. J. Kurth*, J. N. Livermore, R. D. Madison*, G. E. McElroy, L. G. Miller*, D. W. Nelson, G. B. Priester, T. H. Troller.

Air Sterilization: W. F. Wells, *Chairman;* W. T. Anderson, Jr., L. J. Buttolph, C. W. Flood, Jr., Leonard Greenburg, M.D., B. H. Jennings, E. R. Queer*, J. A. Reyniers, Mildred W. Wells, M.D., C.-E. A. Winslow.

Combustion: R. K. Thulman, *Chairman;* P. R. Achenbach, J. F. Barkley, L. L. Connell, R. C. Cross*, R. B. Engdahl, R. C. Johnson, W. B. Kirk, J. W. Miller, W. M. Myler, Jr., H. J. Rose, K. O. Schlentner, E. T. Selig, Jr., T. H. Smoot.

Cooling Load: W. E. Zieber*, *Chairman;* C. M. Ashley, R. D. Blum, W. F. Friend, R. H. Heilman, H. W. Heisterkamp, R. C. Jordan, C. F. Kayan, J. N. Livermore, R. H. Lock, C. O. Mackey*, J. P. Stewart.

Corrosion: L. F. Collins, *Chairman;* A. S. Gates, Jr., A. E. Griffin, E. W. Guernsey, R. L. Hallett, P. G. Kayser, H. A. Pray, F. N. Speller, T. H. Urdahl*.

Heat Flow Through Glass: R. A. Miller, *Chairman;* A. B. Algren*, A. H. Baker, F. L. Bishop, Jr., J. E. Frazier, J. S. Herbert, E. H. Hobbie, L. K. Jones, C. O. Mackey*, F. W. Preston, W. C. Randall, Vic Sanders, H. B. Vincent, G. B. Watkins, F. C. Wood.

Heating Load: T. F. Rockwell, *Chairman;* C. M. Ashley, R. A. Biggs, A. I. Brown, R. C. Cross*, R. S. Dill, W. S. Harris, J. M. Hartman, S. I. Rottmayer, M. W. Shears, G. H. Tuttle.

Industrial Ventilation: W. N. Witheridge, *Chairman;* A. D. Brandt, W. B. Harris, W. C. L. Hemeon, D. E. Humphrey, C. W. Johnson*, J. M. Kane, M. G. Kershaw, L. L. Lewis, L. G. Miller*, H. A. Mosher, B. F. Postman, B. R. Small, R. P. Warren, H. E. Ziel.

Insulation: E. R. Queer*, *Chairman;* R. E. Backstrom, C. B. Bradley, R. B. Crepps, C. H. Jefferson, H. E. Lewis, L. E. Pasek, H. E. Robinson, Vic Sanders, T. D. Stafford, L. V. Teesdale, R. K. Thulman, T. T. Tucker, P. M. Woodworth.

Panel Heating and Cooling: G. D. Winans, *Chairman;* A. B. Algren*, R. L. Byers, P. B. Gordon, L. N. Hunter* (*Ex-Officio*), John James*, J. S. Locke, John Magos, H. F. Randolph, Cyril Tasker (*Ex-Officio*).

Group A—Heat Distribution Within and Behind the Panel: P. B. Gordon, *Chairman;* A. B. Algren*, R. A. Biggs, R. S. Dill, H. L. Flodin, F. E. Giesecke, W. S. Harris, C. F. Kayan, G. D. Lain, C. W. Meininger, D. L. Mills, C. W. Nessell, P. S. Park, S. I. Rottmayer, S. K. Smith, R. K. Thulman, S. M. Van Kirk, G. L. Wiggs, L. H. Yeager.

Group B—Heat Transfer Between the Panel and the Space: John James*, *Chairman;* H. F. Randolph, *Vice Chairman;* C. M. Ashley, J. T. Bergen, C. F. Boester, Wharton Clay, Linn Helander, A. L. Jaros, Jr., H. A. Lockhart, C. O. Mackey*, R. A. Miller, G. W. Penney, G. G. Sward, J. M. van Nieukerken.

Group D—Controls: J. S. Locke, *Chairman;* A. B. Algren*, H. W. Alyea, S. D. Browne, R. L. Campbell, C. M. Garner, P. B. Gordon, W. J. Hajek, A. J. Keating, W. H. Kliever, H. T. Kucera, P. F. Neess, R. S. Penn, J. K. M. Pryke, E. J. Ritchie, C. W. Signor, N. D. Skinner, A. S. Widdowfield.

Physiological Research: C.-E. A. Winslow, *Chairman;* Thomas Bedford, M.D., Capt. A. R. Behnke, MC, USN, E. W. Brown, M.D., A. C. Burton, M.D., E. F. DuBois, M.D., A. P. Gagge, R. M. Graham, M.D., R. W. Keeton, M.D., D. H. K. Lee, M.D., L. G. Miller*, André Missenard, Charles Sheard.

Sorbents: John Everetts, Jr., *Chairman;* F. C. Dehler, M. C. Giannini*, C. H. B. Hotchkiss, E. R. McLaughlin, J. C. Patterson, G. L. Simpson, F. J. Swaney.

Weather Design Conditions: T. H. Urdahl*, *Chairman;* J. C. Albright, P. D. Bemis, H. S. Birkett, J. P. Fitzsimons, J. H. Hart, W. L. Holladay, W. M. Wallace, II.

*Member of Committee on Research.

JOURNAL SECTION

OFFICERS OF LOCAL CHAPTERS AND STUDENT BRANCHES

(40 Chapters—3 Student Branches)

Atlanta: Organized, 1937. Headquarters, Atlanta, Ga. Meets, First Friday. President, L. L. Barnes, 3865 Wieuca Terrace. Secretary, R. L. Beach, 131 Clarion Ave., Decatur.

•

Central New York: Organized 1944. Headquarters, Syracuse, N. Y. President, D. L. Mills, 1407 N. Madison St., Rome. Secretary, J. H. Carpenter, 3515 Midland Ave., Syracuse 7.

Central Ohio: Organized, 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. President, W. M. Myler, Jr., P.O. Box 267, Columbus 16. Secretary, H. G. Hays, 851 W. Third Ave., Columbus 8.

Cincinnati: Organized 1932. Headquarters, Cincinnati, Ohio. Meets First Tuesday. President, M. E. Mathewson, 1211 Enquirer Bldg., Cincinnati 2. Secretary, E. W. McNamee, 1729 John St., Cincinnati 14.

Connecticut: Organized, 1940. Headquarters, New Haven, Conn. President, E. C. Marsden, 44 Hicks St., Hartford. Secretary, T. L. Arnold, 26 Francis Ave., Hartford.

•

Delta: Organized, 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. President, L. V. Busenlener, 2927 Jackson Ave., New Orleans 13. Secretary, Ralph Elizardi, 314½ St. Charles Ave., New Orleans 12.

•

Golden Gate: Organized, 1937. Headquarters, San Francisco, Calif. Meets, First Thursday. President H. V. Hickman, 1129 Folsom St., San Francisco 1. Secretary, R. C. Cushing, 1136 Howard St., San Francisco 3.

•

Illinois: Organized, 1906. Headquarters, Chicago, Ill. Meets, Second Monday. President, C. M. Burnam, Jr., 6 N. Michigan Ave., Chicago 2. Secretary, G. W. Bornquist, 629 W. Washington Blvd., Chicago 6.

Indiana: Organized, 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. President, P. R. Jordan, 311 E. South St., Indianapolis 4. Secretary, C. F. A. Locke, 111 E. 34th St., Indianapolis 5.

Iowa: Organized, 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. President, D. C. Murphy, 840 Fifth Ave., Des Moines 14. Secretary, R. S. Stover, Kresge Bldg., Marshalltown.

•

Kansas City: Organized, 1917. Headquarters, Kansas City, Mo. Meets First Monday. President, H. E. Gould, 1924 Oak Rd., Kansas City 8. Secretary, K. M. Stevens, 1510 Main St., Kansas City.

•

Manitoba: Organized, 1935. Headquarters, Winnipeg, Man., Canada. Meets, Second Thursday. President, J. R. Stephenson, 278 Main St., Winnipeg. Secretary, D. F. Michie, 278 Main St., Winnipeg.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, R. T. Kern, 51 Claflin St., Leominster. Secretary, D. W. Blair, 59 Frost St., Cambridge.

Memphis: Organized, 1944. Headquarters, Memphis, Tenn. Meets, First Monday. President, E. E. Scott, 918 Dermon Bldg., Memphis 3. Secretary, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. President, E. F. Hyde, 708 Oakland Ave., Birmingham. Secretary, J. H. Spurgeon, 5050 Joy Rd., Detroit 4.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, O. L. Lilja, 5000 16th Ave., S., Minneapolis 7. Secretary, E. F. Snyder, Jr., 4324 Zenith Ave., N., Minneapolis 12.

Montreal: Organized, 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. President, Leo Garneau, 25 Salisbury Rd., Pointe Claire, Que. Secretary, R. R. Noyes, 630 Dorchester St. W., Montreal.

•

Nebraska: Organized, 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. President, K. R. Magarrell, 127 So. Main St., Council Bluffs, Ia. Secretary, F. E. Prawl, 308 So. 15th St., Omaha 2.

New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, A. A. Bearman, 444 West 56th St., New York 19. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, E. S. deWitt, 1211 Commercial Bank Bldg., Charlotte. Secretary, R. M. Warren, Jr., 1001 N. Church St., Charlotte 1.

North Texas: Organized, 1938. Headquarters, Dallas, Tex. Meets, Third Monday. President, B. S. Foss, Jr., 711 Construction Bldg., Dallas 1. Secretary, Herman Blum, Jr., 2812 Fairmount St., Dallas 4.

Northern Ohio: Organized, 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. President, W. R. Moore, 5005 Euclid Ave., Cleveland. Secretary, John Richmond, 10210 Woodland Ave., Cleveland 4.

Oklahoma: Organized, 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, J. H. Spaan, Jr., 1303 N. Klein, Oklahoma City 6. Secretary, J. R. Patten, 627 N.W. Second St., Oklahoma City.

Ontario: Organized, 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. President, E. G. Spall, 73 Simcoe St., Toronto 1. Secretary, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets, Thursday after First Tuesday. President, E. R. Lokey, 1238 N. W. Glisan St., Portland 9. Secretary, A. N. Hoss, 621 S. W. Alder, Portland.

•

Pacific Northwest: Organized, 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. President, L. L. Bysom, 1214 Eighth St., Bremerton. Secretary, D. O. Mead, 816 Arctic Bldg., Seattle 4.

Philadelphia: Organized, 1916 Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, J. O. Kirkbride, Fourth & Locust Sts., Philadelphia 6. Secretary, M. E. Barnard, 12 S. 12th St., Philadelphia 7.

Pittsburgh: Organized, 1919. Headquarters, Pittsburgh, Pa. Meets, Second Monday. President, H. E. Park, 201 E. Carson St., Pittsburgh 19. Secretary, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

•

Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, Fred Janssen, 1123 W. Third Ave., Denver 9. Secretary, F. C. Allen, 4467 King St., Denver 11.

•

St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets, First Tuesday. President, B. L. Evans, 571 Stratford Ave., University City. Secretary, C. H. Burnap, 1635 Syndicate Trust Bldg., St. Louis 1.

Shreveport: Organized 1948. Headquarters, Shreveport, La. President, W. E. FitzGerald, 939 Louisiana Ave., Shreveport. Secretary O. J. Dykes, Jr., 1012 Market St., Shreveport.

South Texas: Organized, 1938. Headquarters, Houston, Tex. Meets, Third Friday. President, C. C. Quin, 809 Stuart Ave., Houston 6. Secretary, R. J. Salinger, 4510 Dewberry Lane, Houston 4.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Third Wednesday. President, R. S. Farr, 2615 Southwest Dr., Los Angeles. Secretary, L. J. Helms, 633 S. Berendo St., Los Angeles 5.

Southwest Texas: Organized, 1946. Headquarters, San Antonio, Tex. President, G. R. Rhine, 1208 Alamo National Bldg., San Antonio. Secretary, I. W. Wilke, 422 Congress Ave., Austin.

•

Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, E. J. Watts, 2485 Douglas St., Salt Lake City 5. Secretary, R. H. East, 326 E. First So., Salt Lake City.

•

Virginia: Organized, 1946. Headquarters, Norfolk, Va. Acting President, J. E. White, 7607 Gloucester Ave., Norfolk 5. Secretary D. E. Phillips, P. O. Box 674, Newport News.

•

Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, A. S. Gates, Jr., 621 N. Jackson St., Arlington, Va. Secretary, J. G. Muirheid, 2013 New Hampshire Ave., N. W., Washington 9.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, H. W. Wolters, 820 Staples Ave., N.W., Kalamazoo 54. Secretary, H. R. Limbacher, 760 E. Vine St., Kalamazoo.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, Edwin Woolcock, 2217 15th St., Niagara Falls, N. Y. Secretary, T. F. Killeen, 374 Delaware Ave., Buffalo 2.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, W. A. Ouweneel, 514 E. Ogden Ave., Milwaukee 2. Secretary, H. F. Brinen, 2226 Kinzie Ave., Racine.

Student Branches

North Carolina State College: Organized 1948. Headquarters, Raleigh, N. C. President, J. G. Marshall, North Carolina State College. Secretary, Basil Greene, Apt. D-2, Grosvenor Garden Apts., Raleigh.

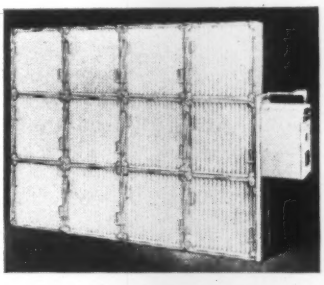
Purdue University: Organized 1948, Headquarters, W. Lafayette, Ind. Chairman, R. G. James, 411 E. 37th St., Indianapolis. Secretary D. M. Long, FPHA Apt. 423-2, W. Lafayette.

Texas A. & M. College: Organized, 1946. Headquarters, College Station, Tex. Meets, Third Thursday. President, S. E. Ammons, 212 13th Ave., No., Texas City. Secretary, C. P. Howard, Box 1706, College Station.

EQUIPMENT DEVELOPMENTS

for your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1948 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Paper Collector Element Used in Electronic Air Filter

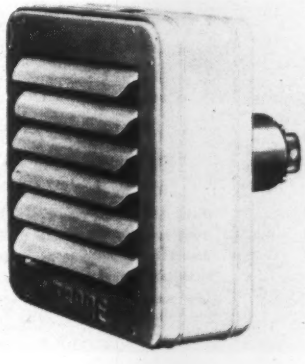


No. 3870 — The "Electro-PL" is said to be a dry type electronic air filter of simplified design and intermediate efficiency in dust removal. Offered by American Air Filter Co., Inc., First and Central Ave., Louisville 8, it is basically an electrostatic precipitator without an ionizing unit. Electrostatically charged "Airmat" paper is the filtering medium.

Cleaning efficiency, at the recommended 35 fpm air velocity, is said to be 60 percent by the discoloration method of testing. Operation may be varied to suit the dust condition, the unit performing either as an electronic air cleaner when a smoky atmosphere is prevalent or as a dry type air filter when conditions are not as severe.

Units are furnished in either the straight bank or v arrangement and the power packs, which utilize 115 volt a-c current, are made in three sizes and capacities. Energy consumption is said to average about 8 watts per thousand cfm of air handled.

Functional Design Featured in New Unit Heater

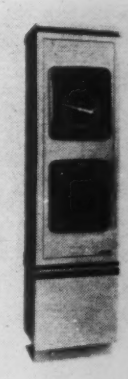


No. 3871 — A newly designed unit heater, the model H, has been announced by The Trane Co., La Crosse, Wis.

According to the company, functional design is the most important feature of the new unit. The casing is in three parts with top, bottom, and sides of one-piece construction. The casing can be quickly disassembled for inspection and cleaning.

A fan shroud and "Free-Flo" grilles or louvers complete the casing assembly. The coil is protected against rapid temperature change expansions and contractions by the use of a new development, the "floating coil" feature. Available with a nonfreeze coil, it is offered in 24 different sizes with capacities ranging from 20,000 to 352,000 Btu per hr.

Offers Packaged Instrument Cabinet for Air Conditioning Control



No. 3872—Among the "packaged unit" instrument cabinets offered by the Foxboro Co., Foxboro, Mass., is one said to be suitable for almost universal application with industrial and commercial air conditioning systems.

The steel cabinet contains a dual range indicator for determining dry bulb and dew point temperatures and a key switch panel for connecting the indicator with multiple resistance bulb circuits for temperature measurement and "Dewcel" circuits for dew point measurement. Capacity of the panel is 96 circuits, or 48 each having two circuit connections and an automatic "off" position at center.

Scale ranges are from —30 to 120 F dry bulb temperature and from —20 to 92 F dew point temperature.

Electronic Temperature Control System Anticipates Requirements

No. 3873—A new "Three-Point" electronic, automatic temperature control unit for small buildings is designed to anticipate heating requirements and to "change the size" of the heating system in accordance with outdoor temperature. The manufacturer is Johnson Service Co., 507 E. Michigan St., Milwaukee. Said to be unusually capable of maintaining comfortable room temperatures and to provide fuel savings, it is an adaptation of the company's "Duo-Stat" control used in industrial and institutional buildings.

Designed for use with hot water and warm air heating systems, the controller is designed to continuously measure outdoor, indoor, and heating system temperatures. All three temperature measuring elements are connected to an electronic amplifier which is used to translate the temperature measurements into controlling action.

[*Continued on page 184*]

Heating, Piping & Air Conditioning [10-48]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each number in which you are interested)

3870	3871	3872	3873	3874	3875	3876	3877	3878	3879
3880	3881	3882	3883	3884	3885	3886	3887	3888	
6992	6993	6994	6995	6996	6997	6998	6999	7000	7001
7002	7003	7004	7005	7006	7007	7008	7009	7010	7011
7012	7013	7014	7015	7016	7017	7018	7019	7020	7021
7022	7023	7024							

Name ..... **Title**.....

Company ....

Address .....

City .... **Zone**.... **State**.....

CHICAGO PUMPS

ENGINEERED BY EXPERTS—BUILT BY SKILLED CRAFTSMEN

HOUSE PUMPS

FIRE AND BOOSTER SERVICE PUMPS

CIRCULATING WATER PUMPS

WATER SUPPLY PUMPS

PNEUMATIC WATER SYSTEMS

BRINE CIRCULATING PUMPS

AIR WASHER CIRCULATING PUMPS

INDUSTRIAL SERVICE PUMPS

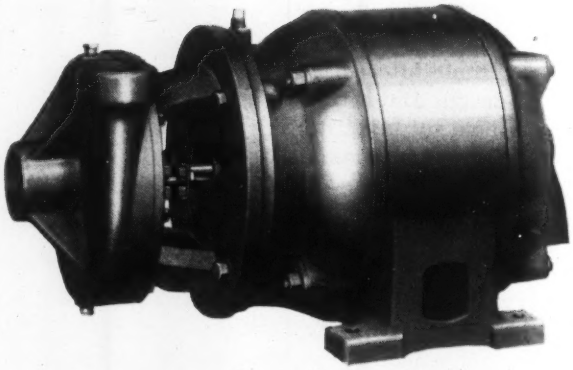


Fig. 2188—Type N Unit-Built Pump. Piping need not be disturbed when disassembling Motor can be moved back. Discharge opening can be placed on either side, up or down.

CAPACITIES UP TO 1,900 G. P. M.
HEADS UP TO 530 FT.

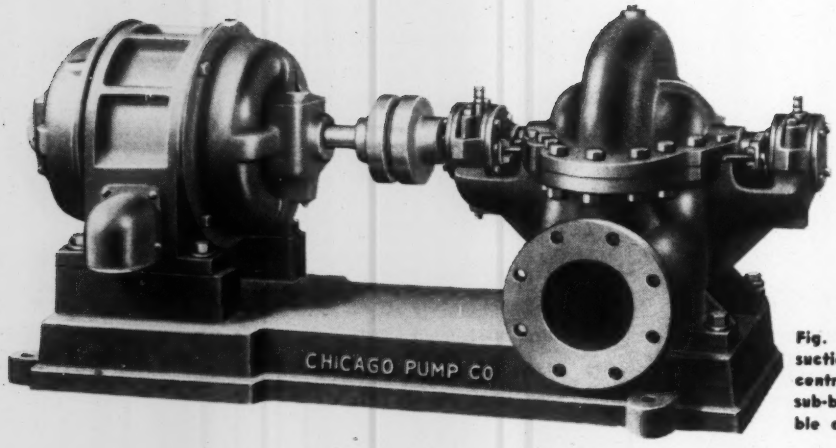


Fig. 1881—Type D single stage, double suction, horizontally split case, volute, centrifugal pump mounted on cast iron sub-base and direct connected by flexible coupling to an electric motor.

OTHER CHICAGO PUMPS

VACUUM — CONDENSATION — CIRCULATING — BILGE — FIRE — HOUSE — SEWAGE — WATERWORKS AND SEWAGE PLANT EQUIPMENT

MORE THAN 100,000 CHICAGO PUMPS IN SERVICE

BUILDING AND INDUSTRIAL PUMP DIVISION

Condensation
Flush-Kleens
Horizontal
Vertical
Vacuum
Sewage
House
Circulating
Bilge and Fire

CHICAGO PUMP COMPANY

General Offices and Plants
2300 WOLFRAM STREET - CHICAGO 18, ILLINOIS
TELEPHONE BRUNSWICK 4110

SEWAGE EQUIPMENT DIVISION

Comminutors
Aeration Equipment
Samplers
PUMPS:
Horizontal
Vertical
Plungers
Flush-Kleens
Scru-Pellers

Another Great Line!

NEW DELCO MOTORS

FOR REFRIGERATION AND AIR CONDITIONING EQUIPMENT

CHECK THESE FEATURES OF THE NEW DELCO MOTOR

- ✓ The inner and outer races of the ball bearing on the end opposite the drive end are locked to give maximum thrust capacity.
- ✓ Polyphase motors have double squirrel cage rotors; die cast aluminum conductor bars and end rings.
- ✓ Close tolerance air gap between rotor and stator.
- ✓ Main frames, end frames of rigid cast iron construction.
- ✓ Extended accessible mounting feet cast as unit with main frame.
- ✓ Single phase available from 1 h.p. through 5 h.p. and polyphase available from 1 h.p. through 7½ h.p. 1800 R.P.M.

Developed especially for compressor service, this new line of Compressor Duty Motors by Delco embodies everything needed to assure long, dependable operation in air conditioning and refrigeration equipment.

The new Delco Compressor Duty Motors are quiet and smooth-running. They're compact, self-ventilated, thoroughly insulated. The rugged cast iron frame permanently protects the inner working parts. The double shielded ball bearings are provided with ample lubrication.

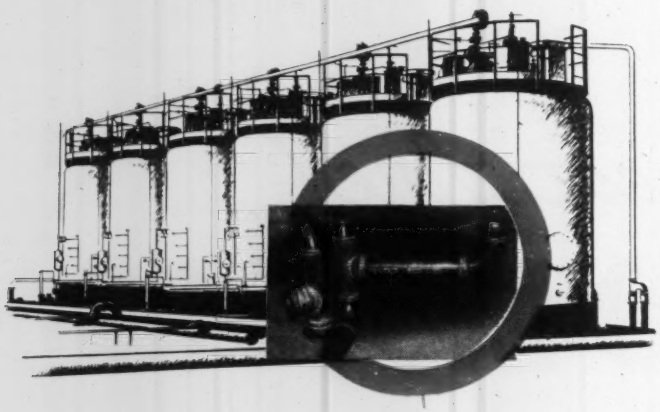
These are just a few of the reasons why this new Delco line will do a better job of powering your compressors. For the full story of their value and quality, write to Delco Products, Dayton, Ohio, or our nearest Sales Office.

DELCO PRODUCTS DAYTON, OHIO

DELCO MOTORS

DELCO PRODUCTS, DIVISION OF GENERAL MOTORS CORPORATION

SALES OFFICES: CHICAGO · CINCINNATI · CLEVELAND · DETROIT · HARTFORD



SALT IS GOOD ON TOMATOES — BUT NOT IN CRUDE OIL

"Salts in crude oil are an annoying headache to refiners. They cause frequent shut-downs because of salt plugging, corrosion from evolved HCl, and the deposition of hard coke. The Petreco Electric Desalting Process, developed by the Petroleum Rectifying Company, effectively eliminates the salt, with a corresponding reduction in the refining probiems it causes. The Petreco Process is widely used by refiners throughout the United States, Canada, and South America.

"The Petroleum Rectifying Company has found that Bonney WeldOlets* and ThredOlets* insure strong, leak-proof pipe connections and are very effective wherever 90 degree branch connections are needed, regardless of the pipe size. Not only do WeldOlets* give the "balanced flow" which is vitally important in their multiple unit operation, but they also speed up layout, save welding time."

ThredOlets* make a stronger connection than couplings, and the use of both WeldOlets* and ThredOlets* gives them savings of 25% and more.

WeldOlet Fittings can be welded to pipes wherever outlets are required, eliminating costly pipe threading, reducing new construction and maintenance costs. They are safe, efficient, quickly installed.

Write today for our handbook. It may suggest ways in which WeldOlet Fittings can cut *your* labor costs. There is a distributor in every principal city.

YOU GET 7 IMPORTANT ADVANTAGES WITH WELDOLETS*. .

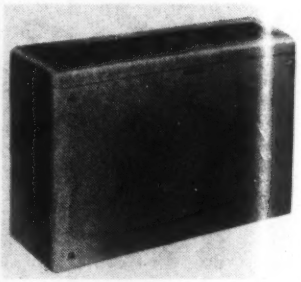
1. Full pipe strength
2. Ease of installation (no forming, fitting, aligning, beveling)
3. Ease of inspection (icicles, weld metal and flash easily seen—easily removed)
4. Improved flow conditions
5. Uniform appearance
6. Reduced weight and space
7. Highest quality installation at minimum cost

BONNEY FORGE & TOOL WORKS
Forged Fittings Division,
350 Green Street
ALLENTOWN, PENNA.
MANUFACTURERS OF FAMOUS BONNEY TOOLS

WELDOLETS
*TRADE MARK REG. U.S. PAT. OFF. PAT. IN U.S. & FOREIGN COUNTRIES
FOR WELDED BRANCH PIPE OUTLETS
When you want Bonney Welding Outlets, ask for WeldOlets*

[*Continued from page 181*]

Cabinet Type Unit Heaters Designed for High Capacity



No. 3874—Young Radiator Co., Racine, Wis., has developed a new line of cabinet type unit heaters which feature cabinet styling so as to blend with and, according to the manufacturer, enhance the appearance of lobbies, vestibules, auditoriums, recreation halls, commercial buildings, and similar locations.

Units are said to deliver high capacity heat output without excessive blast and to offer full unit heater performance. They are equipped with a removable blower assembly and resiliently mounted motor.

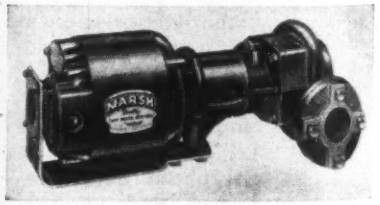
Designed for use with either steam or hot water systems, the new line consists of three models with three sizes in each style. Tubes and fins are nonferrous with the tubes rolled into gray iron castings. Rolled-in tube joints are said to assure low pressure drop.

Axial Flow Fan Ventilates Vehicles

No. 3875—A 23 in. "Axiflow" ventilating fan was exhibited by Westinghouse Electric Corp., P. O. Box 868 Pittsburgh 30, Pa. at the recent Railway Electric Supply Manufacturers Association meeting. This fan is designed to ventilate electric surface vehicles, subway and suburban cars, and railroad coaches.

According to the company, several of these fans, built into the ceiling structure of the vehicle, draw in large volumes of outside air and diffuse it evenly throughout the passenger space. The volume of air handled by each fan varies up to 3500 cfm, depending upon fan speed and static air resistance of ductwork. Thermostatic controls are used to vary the motor speed in accordance with air temperatures within the vehicle, the maximum motor speed and air volume occurring at elevated temperatures.

Interchangeable Mounting Features Circulating Pump Design



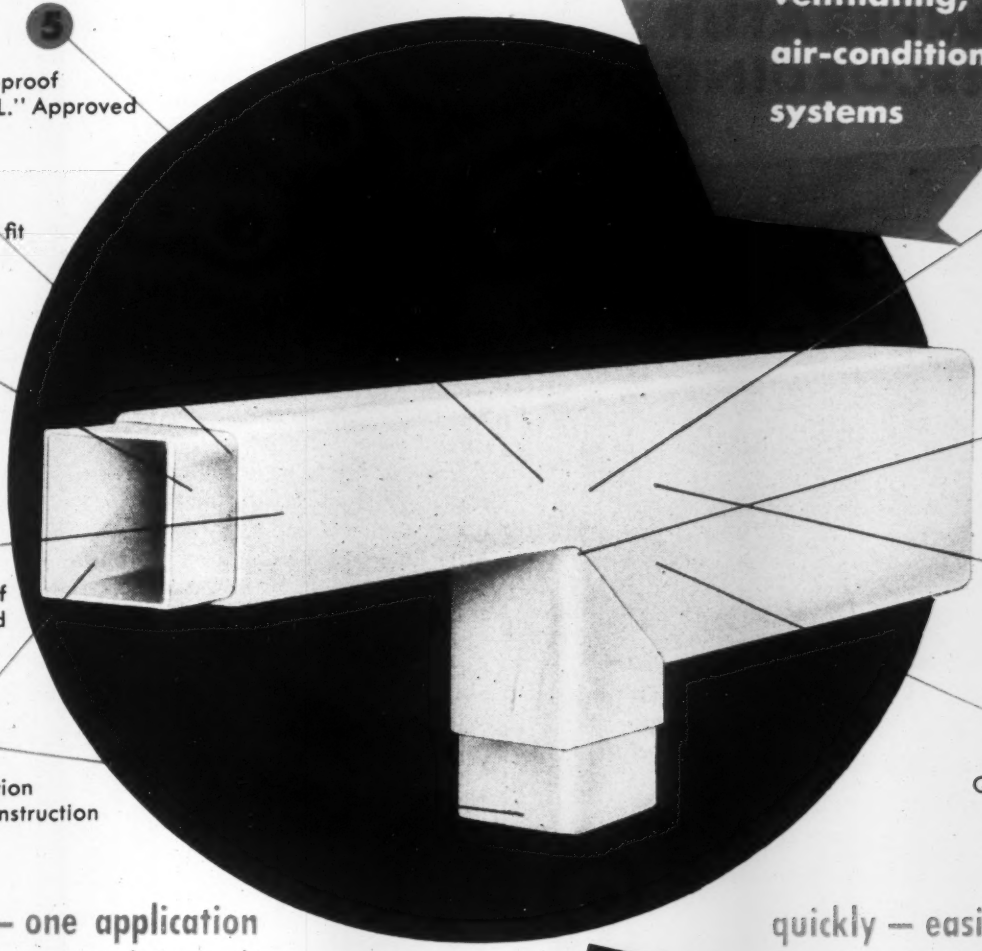
No. 3876—A new two-position circulating pump which can be mounted in either the horizontal or vertical position is now being offered by Marsh Heating Equipment Div., Jas. P. Marsh Corp., Skokie, Ill. According to the manufacturer, mounting changes are simple, requiring the manipulation of only four bolts.

Other features of the pump are said to include a special rubber coupling, with brass inserts, that is secured to the motor shaft and pump shaft to reduce transmission of vibration. The pump shaft rotates in an "Oilite" bearing which is fed through an oil cup in the housing and which is kept watertight by a carbon seal and a neoprene seal around the pump shaft. Power is supplied by a Jack & Heintz 1/6 hp motor operating on 110 volt, 60 cycle current. The pump is available with either 1¼ or 1½ in. pipe.

all-asbestos Carey duct

moves air at up to 50% greater velocity with same duct area!

for modern heating, ventilating, air-conditioning systems


5 Fire-proof "U. L." Approved
6 Snug-sliding fit
7 Inner core of high density and strength
8 Outer jacket of fine corrugated asbestos
9 Fast Installation Slip-joint construction
4 Easy-to-handle Units 3' long
3 Leak-proof
2 Insulated
1 Quiets Noise

two jobs — one application

You'll cut down costs of time and materials when you put in *all-asbestos* Careyduct . . . because both duct and insulation are combined in this one product . . . installed in one operation.

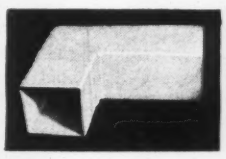
Careyduct is 40% to 50% quieter — hushes fan noises — eliminates rumbles and vibrations. Comes in forty-two standard sizes. Combined thicknesses of core and jacket is ¾". Weighs less than 2 lbs. per sq. ft.

For more Careyduct details write for the new Careyduct Folder.
(A.I.A. File No. 23-D)

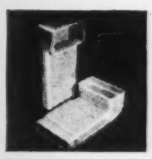
quickly — easily installed

Careyduct can be installed quickly, easily by qualified sheet metal workers. Fittings are made on the job. No special tools required. Careyduct is the air conveyor that means savings in cost—better appearance—permanent and superior service.

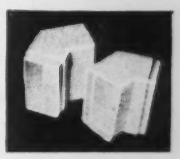
90° ELBOW



STACK-HEAD



45° ELBOW



Carey

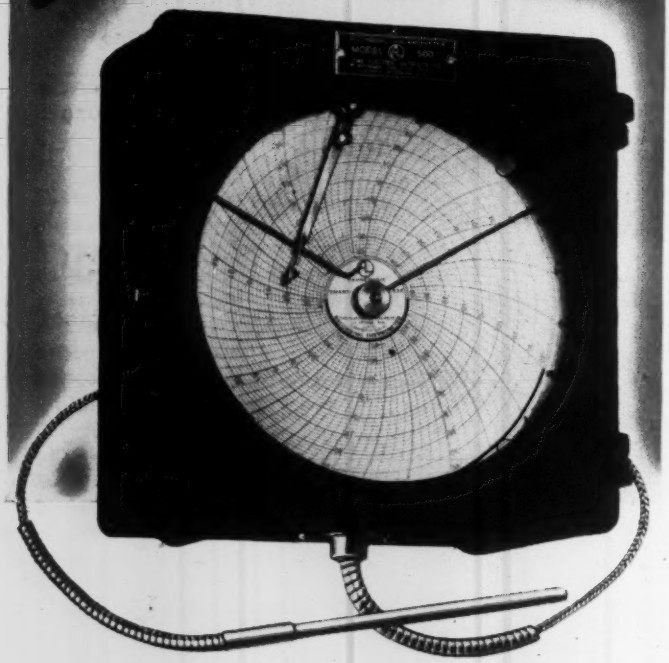
75 years serving home and industry

THE PHILIP CAREY MANUFACTURING COMPANY, CINCINNATI 15, OHIO

In Canada: The Philip Carey Co., Ltd. 1557 MacKay St., Montreal 25, P. Q.

OTHER CAREY PRODUCTS: Industrial Insulation (Asbestos, Magnesia, Rock-Wool); Asbestos Wallboard; Corrugated Roofing & Siding; Waterproofing Materials; Built-up Roofing; Roof Coating & Cements

Depend on
AUTO-LITE
for TEMPERATURE RECORDING



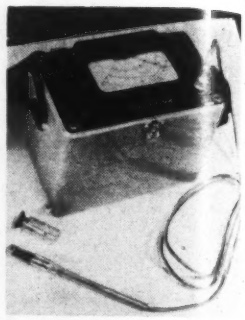
Model "500" is equipped with capillary tubing for remote reading. Priced from $37.50

THIS Auto-Lite Recording Thermometer is designed for utmost efficiency and dependability. Its vigilant recording of continuous operating cycles furnishes money-saving proof of temperature behavior. 6-inch chart with sub-divisions uniformly spaced. Model "500" Recording Thermometer is not affected by altitude or by the temperature of the room in which it is located. All readings represent true temperatures at the point where the bulb is inserted. Write for illustrated catalog describing the Recorder and other styles and types of Auto-Lite thermometers.

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION · TOLEDO 1, OHIO
NEW YORK CHICAGO SARNIA, ONTARIO

INDICATING & RECORDING
THERMOMETERS

Indicates Air Velocity, Air Temperature, and Static Pressure



No. 3877—The "Anemotherm" is a three-way air meter designed to give air velocity, air temperature and static pressure readings at the turn of a knob. It has been developed by Anemostat Corp. of America, 10 E. 39th St., New York 16.

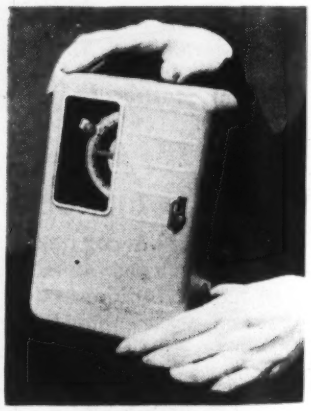
The unit is said to measure velocities from 10 to 5000 fpm and temperatures from 30 to 155 F. Either negative or positive static pressure may be read directly in inches of water from 0.05 to 10 positive and 0.05 to 4 negative. According to the company the device will accurately measure the slightest drafts, and the meter gives instantaneous direct readings.

Combines Deflecting Air Vanes and Ornamental Grille

No. 3878—Recently developed by Hendrick Mfg. Co. Carbondale, Pa., and tested at the Case Institute of Technology, the "Bulator" air grille is said to combine attractive appearance and adjustable air throw and spread.

A wide variety of ornamental grilles are available and these are used in conjunction with the company's deflector vanes which may be adjusted for directional flow. According to the company, the vanes are not noticeable behind the grille, and in addition, the grilles have little effect on the air stream pattern and throw.

Automatic, Manual Control of a Single Circuit Provided by Time Switch



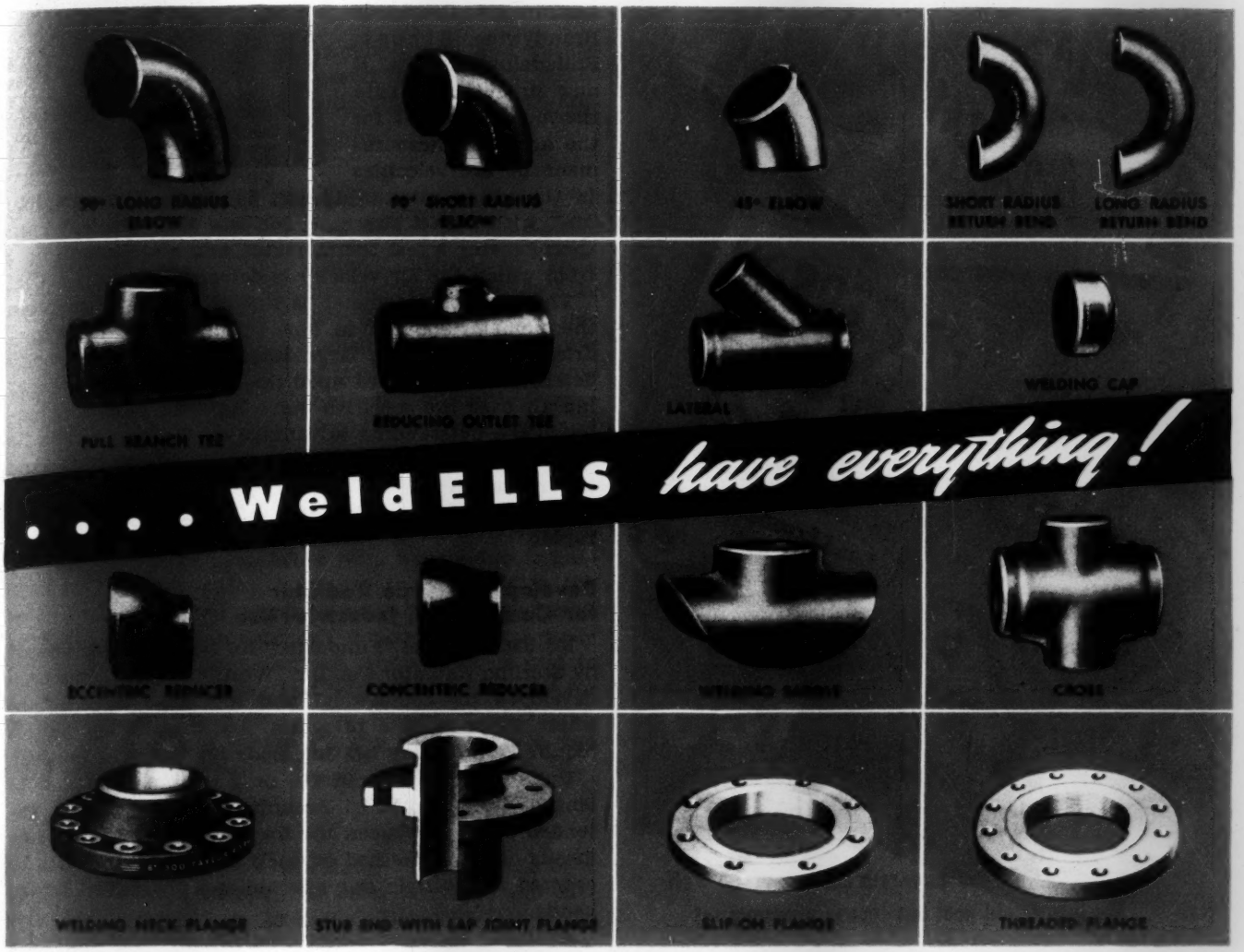
No. 3879—A handy time switch, type T-47, rated 35 amp at 115 and 230 volts and timed and operated by a synchronous, self starting, permanently lubricated "Telechron" motor, has been developed by the Meter and Instrument Div., General Electric Co., Schenectady 5, N. Y.

The switch is said to have wide application on farms, in stores, small industries, and in apartments.

Designed for "On" and "Off" timing of a single circuit, the switch will perform one operating cycle during any 24 hr period and will continue to do so daily without adjustment. It has a single pole, single throw mechanism with silver, snap action contacts. It is equipped with a large 24 hr clock dial.

Operation can be manual or automatic. Adjustable switch tripping clamps permanently attached to the dial are used for setting the switch for automatic operation. These clamps are designed to allow a minimum setting of 5 min and a maximum setting of 22 hr between "On" and "Off" operations. Manual operation is independent of automatic dial settings.

Accept no less than the FULL LINE!



Whatever the conditions: Extreme temperatures . . . . extreme pressures . . . . steady flow or shock service . . . . corrosion resistance . . . product purity.

Whatever the material: Forged carbon steel . . . wrought iron . . . . carbon or chrome moly . . . . Stainless 304, 347, 316 . . . . Monel . . . . Nickel . . . . Inconel . . . . Aluminum . . . . other usual industrial materials.

Whatever the size or weight: Forge-formed fittings in the entire size range from ¾" all the way to 30" (or larger!): in all the usual or special weights necessary for *any* service condition; with a companion range of seamless forged and forge-rolled flanges of every type, in *all* ASA sizes and pressure series, or beyond, as large as 96" diameter.

Whatever your requirement: Taylor Forge provides the most complete line. Accept no less!

TAYLOR FORGE

TAYLOR FORGE & PIPE WORKS General Offices & Works: Chicago 90, Ill. (P.O. Box 485) Eastern Plant: Carnegie, Pa. Western Plant: Fontana, Calif. • District Offices—New York: 50 Church Street • Philadelphia: Broad Street Station Bldg. Chicago District Sales: 208 S. LaSalle Street • Houston: City National Bank Bldg. • Los Angeles: Subway Terminal Bldg.

Get Catalog 484 Just out!

Brand-new Taylor Forge Catalog 484 brings you up-to-date on welding fittings and flanges, and the technical data you want at your elbow. Send for your copy!

Send me catalog 484

NAME_____

POSITION_____

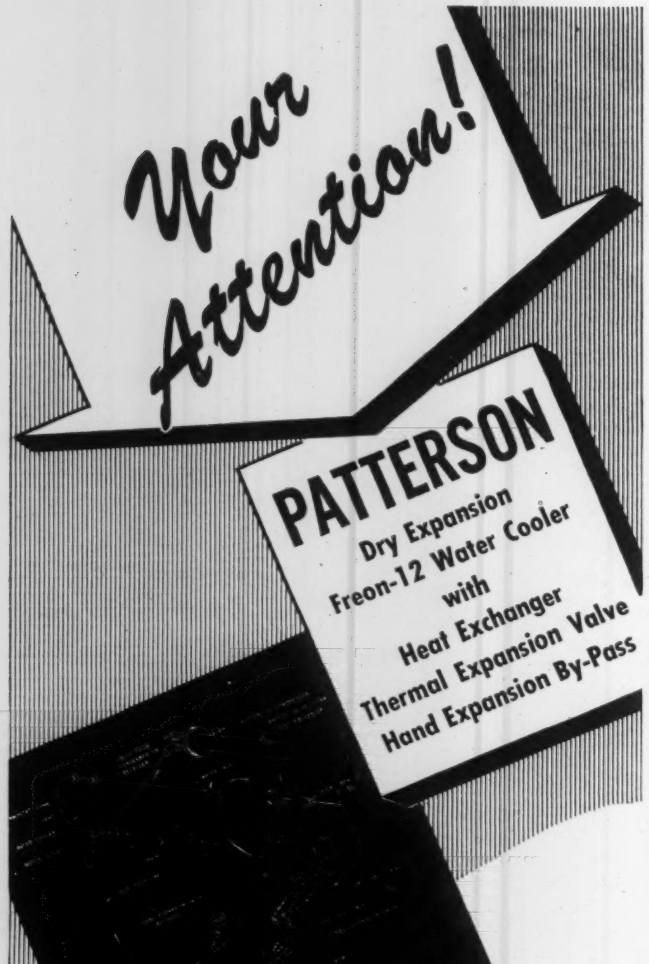
COMPANY_____

STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

510-1048

MAIL TO TAYLOR FORGE & PIPE WORKS
P.O. BOX 485, CHICAGO 90, ILL.



It's a compact, efficient, and effectively controlled water cooling system with a wide range of capacities. It's a carefully engineered system with each size conservatively rated. Perhaps it is just what you need for your cooling requirements. If not, we have other combinations.

Our new Freon Cooler Catalog gives details of over 100 different sizes ranging from 18.4 to 1421 square feet of cooling surface. If our standard units will not provide the unit needed, we are in position to design special coolers, special both as to type and to size. In sending for this catalog, outline your cooler requirements; keeping in mind that the design and manufacture of coolers and other "heat transfer" equipment has been our specialized business for many, many years.

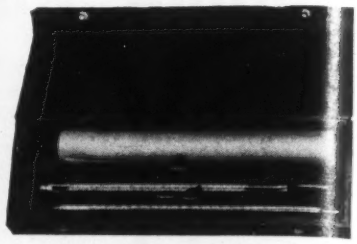
EST. 1880

THE PATTERSON-KELLEY Company, Inc.

107 WARREN STREET, EAST STROUDSBURG, PA.

New York Office: 101 Park Avenue, Zone 17
Offices or Representatives in Principal Cities

Offers Thermometer Kit for Measuring Air Velocities



No. 3880—The Precision Thermometer and Instrument Co., 1506 Brandywine Street, Philadelphia 30, Pa., is now producing a kata thermometer outfit for the accurate measurement of air velocities in the range between 10 and 600 fpm. The complete unit, with pocket size case, consists of a "Princo" kata thermometer, a test thermometer, and a reference chart from which the air velocity is determined.

The kata thermometer is an all glass etched stem thermometer about 10 in. long with a spirit filled, cylindrical bulb having a large surface area. The velocity determination is based upon the cooling action of moving air over the sensitive bulb. According to the company, the outstanding advantage of this method is its accuracy at relatively low velocities and the fact that the indication of velocity is independent of the direction of the air stream, even if the direction is changing rapidly.

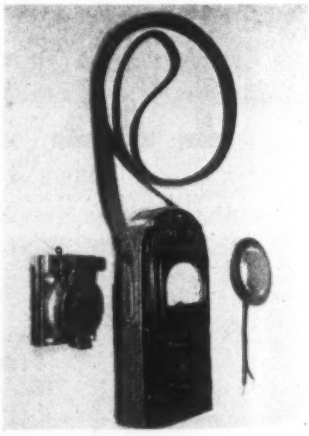
Develops Fin Type Radiator for Commercial, Industrial Use

No. 3881**—The "Finmaster" fin type radiator offered by Sterling Radiator Co., Inc., Westfield, Mass., has been developed for commercial and industrial applications where space is at a premium, low installation cost is required, and where heating loads are heavy or unusual.

Units are available in 1¼ or 2 in. pipe size and in lengths from 2 to 12 ft. According to the company, extended contact between the fin and pipe is provided by means of a hub formed on each fin. Units may also be ordered as multiple tier assemblies with welded return bends.

Available accessories include grille covers of expanded metal and wall brackets for mounting. This radiation is recommended for use with hot water or steam up to 125 psi.

Resistance Thermometer Used for Remote Temperature Readings



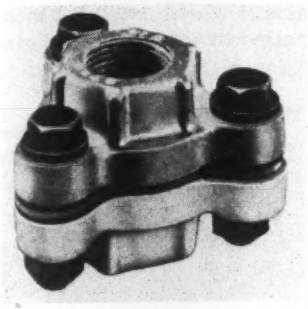
No. 3882**—The line of electrical resistance thermometers offered by Thompson Research & Mfg. Co., Davenport, Fla., includes a two point, battery operated "Thermalbridge" indicating instrument which is used in conjunction with a bulb thermometer or a "Thermal-Blister."

Said to be especially suitable for use in laboratories, freezing and cold storage plants, refrigerated vehicles, etc., either the bulb thermometers or the blisters are mounted inside the space where temperatures are to be checked. The blister shaped coil is 3 in. in diam-

eter and consists of resistance wire embedded in cellulose acetate fiber filler covered with a metal front and plastic back. Both the blisters and the bulb thermometers are wired to weatherproof receptacles, to which the indicating instrument is plugged when readings are to be taken.

According to the company, a number of temperature ranges are available. These extend from —100 to 100 F. Shown here are the outlet, indicating instrument, and blister type thermocouple.

Insulating Union Fitting Eliminates Electrolytic Corrosion



No. 3883—The "Dielectric Union" offered by Hotstream Heater Co., 2363 E. 69th St., Cleveland 4, is designed to increase the life of piping systems by eliminating electrolytic corrosion where ferrous and nonferrous metals are joined.

The union consists of two flanges—one of iron and the other of bronze. Both parts are insulated from each other by a nonconductor gasket and the connecting bolts are insulated from the bronze section of the union by nonconductor bushings. According to the company, all ferrous parts are rustproofed to insure longer service. Installation is said to be both simple and quick and to eliminate the need for a standard gasket union.

The union is now offered in only the ¾ in. size but other sizes are planned.

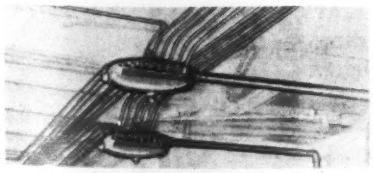
Slide Rule Simplifies Air Duct Sizing

No. 3884—An air duct calculator, in the form of a heavy cardboard slide rule, has been developed and patented by Thomas M. Jackson, P. O. Box 2091, Detroit 31.

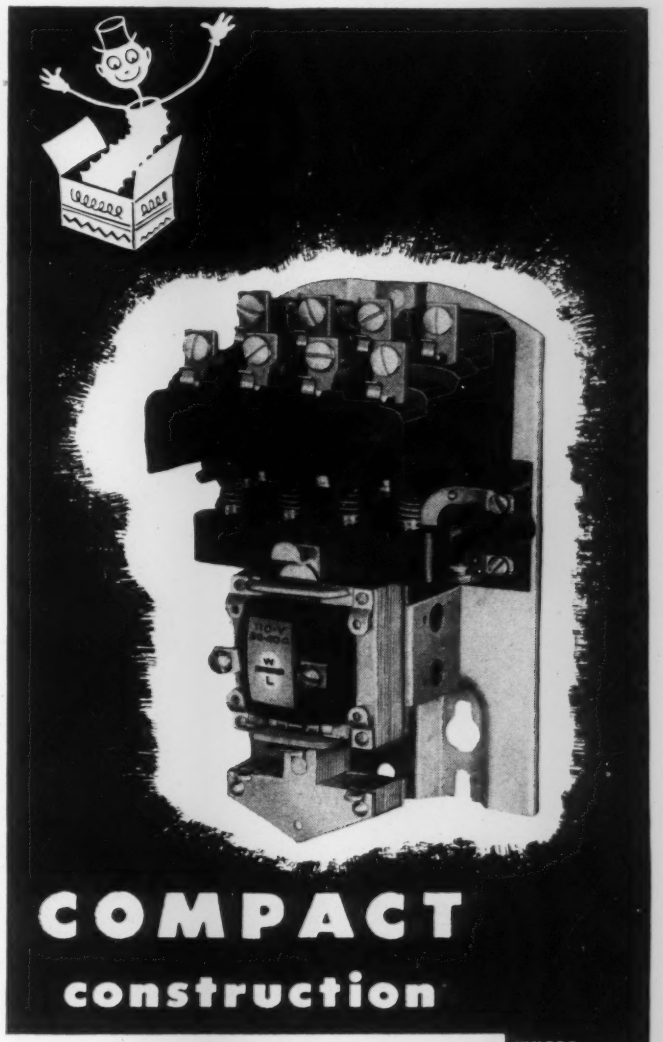
The relationship between round duct diameter, cfm, and air velocity may be determined for air quantities from 100 to 500,000 cfm and for diameters from 5 to 100 in. Friction losses in inches of water per 100 ft. of duct, with joints, and rectangular equivalents of round ducts may be determined by moving the scales.

The back of the calculator contains sliding scales for finding the weight of galvanized iron ducts, U.S.S. gage, including laps and seams for round ducts having diameters from 5 to 100 in. and for the corresponding equivalent rectangular ducts. Also included are tables of recommended gages and duct velocities and a chart showing the friction losses in lineal feet of duct 1½ radius elbows (R/W).

Develops Manifold Unit for Hot Water Heating



No. 3885** — The "Autostributor" is a cast iron manifold unit designed for use with forced hot water heating systems. Offered by Autostributor Co., 238 Mill St., Lansing, Mich., it is installed in the supply and return mains near the



New Contactor has maximum capacity for minimum space, and long life

With a minimum of parts, Ward Leonard's new size #1 a-c solenoid contactor is unusually compact. Assembly in your product is simplified by fact that contactor was designed to meet machine tool requirements. Adaptable to many applications where space is limited. Easy to look at, but doesn't need looking after.

Ward Leonard contactors are "Result-Engineered". By modifying a basic design, Ward Leonard can often give you the results of a special . . . for the cost of a standard.

Write for Contactor Catalog. Ward Leonard Electric Co., 24 South St., Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

WHERE BASIC DESIGNS IN ELECTRIC CONTROLS ARE RESULT-ENGINEERED FOR YOU

WARD LEONARD ELECTRIC COMPANY

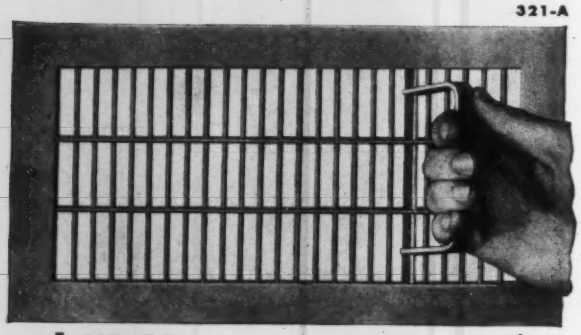
RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

INDEPENDENT

"Fabrikated" WALL GRILLES for Commercial Installations

PROVIDE ADJUSTABLE DIRECTED AIR FLOW

321-A



UP OR DOWN

RIGHT OR LEFT

311-A

Made to fit openings in even inches from 8" x 4" to 60" x 40"

Independent Fabrikated* Adjustable Grilles (patented), rigidly constructed with stamped steel rims and steel bars, are made with either vertical or horizontal grille bars. Grille bars are *adjustable* before or after installation; available also with bars permanently set for straight flow.

Write for new Catalog No. 48—gives schedule of sizes, details and prices.

Always Leading — Always Progressing

*Reg. U. S. Pat. Off.

THE INDEPENDENT REGISTER CO.

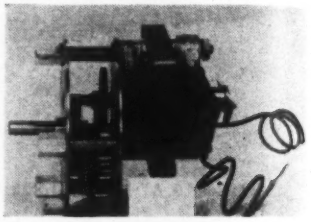
3747 E. 93rd STREET · CLEVELAND, OHIO

boiler. From each unit as many as 16 small supply and return branch lines (generally $\frac{3}{8}$ or $\frac{1}{2}$ in. copper tubing) are run to each radiator, convector, baseboard loop, or radiant panel.

Inasmuch as water velocity is temporarily reduced in the unit, an automatic vent or expansion tank line is mounted in the top of the device. Advantages are said to include reductions in the cost of larger pipe and fittings, adaptability to zoning, the ease with which lines may be concealed, and simplification in venting.

According to the company, zoning on the larger installations is accomplished by extending the supply from the boiler and by installing units in locations central to each zone. For larger installations which are not zoned, a number of units may be installed in series, since $1\frac{1}{4}$ in. tappings are provided at each end.

Small Gear Motors Have Wide Range of Speeds



No. 3886*—The series 500 gear motors are designed to offer a wide range of synchronous and nonsynchronous speeds on the final shaft from 400 rpm to one revolution per day. According to the manufacturer, Gleason-Avery, Inc., Auburn, N. Y., the relatively high torque developed makes these motors suitable for many applications and any of the company's instrument and timing motors can be assembled with these gear trains for special uses.

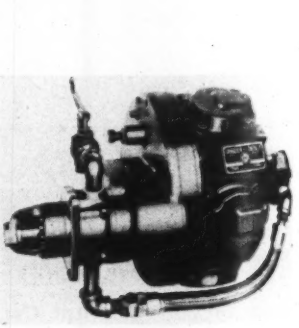
The range of torque developed is from 2.2 to 240 in.-oz and the numerous applications are said to include cycle controllers, dehumidifiers, evaporators, heaters, indicating controllers, recording and controlling instruments, photoelectric cell controlled devices, potentiometers, signal devices, timing relays, and valves.

Mechanically Bonded Fins Used in Baseboard Convector

No. 3887**—Sterling Radiator Co., Inc., Westfield, Mass., is offering a line of baseboard heating units which are said to feature the company's "hubbed" contact between steel fins and 1 in. pipe. In addition to the metal front casing and heating element, hanger strips and $\frac{1}{8}$ in. insulating backing are furnished. Also available for installation of the front casing are end cover, corner, and splice plates.

Elements are furnished in lengths from 2 to 12 ft. and in increments of 6 in. With average radiator water temperatures varying from 170 to 215 F, corresponding outputs are said to range from 370 to 600 Btu per lineal foot of heating element.

Radial Cylinder Design Used in Air Starters



No. 3888—A line of air starters for gas, gasoline, or diesel engines — including five sizes which develop from 3 to 15 hp on 100 psi air pressure—has been announced by Gardner-Denver Co., Quincy, Ill.

Principal advantage of these air starters, according to the company, is their

high torque which makes them especially desirable for diesel applications involving high starting loads. The five cylinder radial design is said to provide even torque through the operating cycle.

An exclusive feature is an air actuated starter pinion which, when the air valve is open, automatically engages the ring gear a split second before the starter begins to crank the engine.

Equipment Shorts

Production at Republic Steel Corp's new Enduro plant No. 2 in Massillon, Ohio, is now under way. The new facilities substantially increase the company's capacity for production of stainless steel sheets in widths up to approximately 60 in.

Hoffman Specialty Co., Indianapolis, has acquired the Blake Mfg. Co., Rock Island, Ill., formerly known as Blake Specialty Co. The Blake line of drainage fittings will become a division of Hoffman, and all correspondence, orders, shipments, and other business matters will be handled at Indianapolis.

A three year program for expansion of development and production operations has been started by Brown Instrument Div., Minneapolis-Honeywell Regulator Co. as the second step in its $2.5 million physical expansion. The first part of the three year program has resulted in the hiring of 40 newly graduated engineers. The plan, which calls for speedy indoctrination of the new engineers, means an immediate expansion of the company's development engineering by 30 percent and by 10 percent in application, industrial, and general engineering.

A new series of factory conducted two week training schools for commercial refrigeration and air conditioning dealers and their salesmen is being started this month by Frigidaire Div., General Motors Corp. The new series of schools is being conducted on a continuing basis by the factory and will include the use of films, recorded sales demonstrations, dramatized presentations, student participation, and plant tours.

Armco Steel Corp. has purchased the assets of Jackson Tube Co., Inc., Piqua, Ohio. The Piqua company is being operated as the tubing division of Armco and Samuel E. Jackson, its president and founder, is managing the new division.

A license agreement between Refrigeration Engineering, Inc., Los Angeles, and Baker Ice Machine Co., Inc., South Windham, Maine, and the Northwest Baker Ice Machine Co., Inc., Seattle, has been made whereby Baker will be permitted to manufacture "Recold" water defrost coils under its own name.

RD-119 is a new additive now being used in all of the petroleum products, such as gasoline, kerosene, fuel oil, and diesel oil, of the Sinclair Refining Co. According to the company, the new product is highly efficient in eliminating rust and scale on metal surfaces—only a little more than 2½ gal being required to give rust preventing qualities to 42,000 gal of petroleum products.

ADSCO
storage
water
heaters
ADSCO
HORIZONTAL
and VERTICAL
Made in a complete line of sizes built to specifications. Available in steel, copper-silicon alloy, nickel clad steel and other materials to suit requirements.
Also instantaneous heaters, economizers and other types of heat exchangers. Write for Bulletins 35-75 and 35-76.
AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
SINCE 1877

A POWER DRIVE
that's a cinch
TO HANDLE

RIDGID Model "400" turns pipe for your hand threaders, cutters, reamers

Model "400" can be bolted to bench or made a stand with 1" pipe legs.

Easy to lift into your truck.

• Lightest, easiest-to-handle power unit made, this job-tested "400" that weighs just over 100 lbs.—a cinch for one man to carry. 3-jaw lathe-type chuck in front, chuck wrench ejector; self-centering work-holder in rear turns with pipe. Universal motor—forward and reverse, light-socket power. No oil to spill, lubrication sealed in. Model "400" comes equipped with handy tool tray, fittings and feet but without legs. A real work-saver. Buy it at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

Equipment Shorts (Cont.)

"Tri-Clad" totally enclosed, fan cooled motors are now available in popular sizes from 1 to 20 hp equipped with a newly developed corrosion resistant "Textolite" cooling fan. According to the manufacturer, General Electric Corp., Schenectady 5, New York, the incorporation of this new fan in these standard, corrosion resistant cast iron motors now makes them especially suitable for use in corrosive atmospheres. The fan, which is nonsparking, has also been incorporated in the company's totally enclosed motors designed for use in hazardous gas or dust locations.

L. J. Mueller Furnace Co. has honored 13 employees who have been with the company for more than 30 years by presenting them with gold watches. The individuals who comprise this group have served the organization a total of 462 years.

Another series of three dealer meetings has been held by York-Shipley, Inc. in Newark, N. J., New York City and Utica, N. Y. More than 250 distributors and dealers attended the sessions which centered around a film presentation of the company's products, policies, merchandising plans, and dealer program.

Jas. P. Marsh Corp. has acquired the Witt Gauge Div. National Pressure Cooker Co. The identity of the Witt line will be preserved, but the gages, including those for oxygen and welding will be produced in the Marsh plant by the new Witt Gauge Division.

The consolidation of the movement of both personnel and equipment into its new 19 acre plant site at Indianapolis has been completed by Peerless Pump Div. Food Machinery Corp. The new plant is the former Fall Creek Ordnance works and was acquired from the War Assets Administration late in 1946.

Completion of a large building program which will permit extensive increases in both production and employment has been announced by the Peerless Foundry Co. All parts of the plant which were damaged or destroyed by fire in 1945 have been restored and re-equipped. In addition, an entirely new foundry has been erected and equipped. Here, castings will be produced for the new Peerless subsidiary, the Round Oak Co. acquired last year.

A three day sales meeting, at which nearly 80 sales representatives from factory branch offices and from distributors' organizations met, was held at Bedford Springs, Pa. This was the first general sales meeting of the Janitrol Heating Div., Surface Combustion Corp. to be held since 1940. The company has instituted a new advertising campaign in which its line of gas fired unit heaters will be featured along with information on commercial applications and industrial installations.

Crise Mfg. Co. has announced that extensive alterations have been completed at its plant in Columbus, Ohio. Additional machine tools have been purchased and straightline assembly methods installed.

Prismatic light directing glass blocks for exposure to direct sunlight and soft-light edge blocks to control brightness contrast between edges and block faces have been developed by the Pittsburgh Corning Corp., Pittsburgh, Pa. According to the company, the new prism block, which is for use on east, south, and west elevations exposed to direct sunlight, incorporates improved prism construction on the interior of the blocks. This is said to minimize brightness contrast so as to give a uniform diffusion by redirecting all transmitted light to the ceiling and rear of the room. The soft-light edge block has an intermediate glass between the halves of glass blocks. This is designed to control light diffusion and edge brightness.

According to Dow Chemical Co., Midland, Mich., pentachlorophenol is, for the first time, being offered as protection from decay and insect attack of wooden and wood lined pipe, products of Michigan Pipe Co., Bay City, Mich. The material is said to be highly toxic to all decay producing fungi, as well as termites and other wood destroying insects. It is also said to be nonvolatile and insoluble in water and to be free from objectionable odors. It can be mixed with inexpensive oils so that painting can be done after the wood has been treated. The pipe company furnishes a widely diversified field of users with pipe, stacks, towers, flumes, tanks, etc.

All standard catalog items in the line of heat transfer products offered by Bush Mfg. Co. have been priced delivered to the nearest freight station anywhere in this country or Canada. In other words, prices are now shown f.o.b. destination, but the company reserves the right to select the routes over which shipments will be made.

"E-Z" code identification markers, self-adhesive strips designed to speed up and simplify the coding of pipes, conduits, and cables, are now available mounted on a new tab which is said to make faster and easier application. According to the manufacturer, Western Lithograph Co., 600 E. 2nd St., Los Angeles 54, Calif., the markers provide a permanent, easy-to-read coding system that is unaffected by temperature or humidity. Thirty six stock code items are available and these conform to the recommendations of the American Standards Association.

The average industrial motor ranging up to 50 hp is too heavy to "lug" into the office of a prospective user for examination. U. S. Electrical Motors, Inc., has developed miniature models exact as to detail but a fraction of the size of its "Varidrive" motors. The models are carried in a traveling case and have a plastic cover which affords full vision to the internal operating parts. They are plugged into a light socket for demonstration.

The new plant of Thermoid Co., at Nephi, Utah, is now approaching 75 percent operation, according to a recent announcement. Industrial belts, including conveyor, transmission and the v type, together with hose of all types and molded products, are being manufactured in the new plant.

GEARED THREADER *designed for* EASY HANDLING

RIDGID No. 4P gives perfect threads on 2½" to 4" pipe

• The 4P is designed for fast accurate threading with a minimum of muscle fag for you. Loop handles make it easy to pick up, carry, put on pipe, even when you're tired and it's greasy. You quickly set mistake-proof plate type workholder to size *before putting it on pipe.* Only one screw to tighten—no bushings to fuss with and lose. Gear is enclosed, safe, dirt-proof. Ratchet handle furnished; RIDGID universal drive shaft available for power drive. The RIDGID 4P is a real work-saver; see it at your Supply House . . . soon.

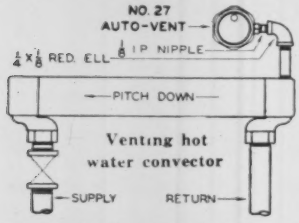
Loop handles make the 4P easy to pick up, carry, put on pipe.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

A SURE THING!

STOP Hot Water Circulation Troubles!

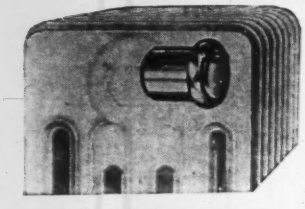
Now You Can AUTOMATICALLY Vent Out the Air that Causes "Sick" Radiators and High Cost Heating



Thousands of contractors have already seen the light!

Instead of taking a chance on manually operated vents (air chamber plus copper tubing plus key valve), they now use Maid-O'-Mist AUTOMATIC Air Eliminators as standard equipment on their hot water jobs.

And when you figure total costs — **labor and materials** — they say that Maid-O'-Mist AUTO-VENTS actually cost LESS installed. Think of the customer good-will they build.



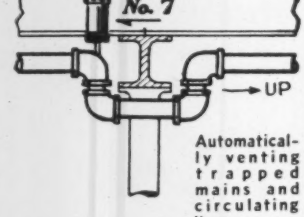
AUTO-VENT installed on hot water radiator.

CASH IN
ON THIS PROFITABLE IDEA

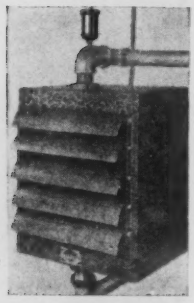
By automatically and continuously VENTING OUT the air as it accumulates in a convector, you're certain to get satisfactory, low cost heating.

That's exactly what Maid-O'-Mist AUTO-VENTS do!

They are FULLY automatic, trouble-free. At least stock a few to "iron out" trouble jobs!



Automatically venting trapped mains and circulating lines.

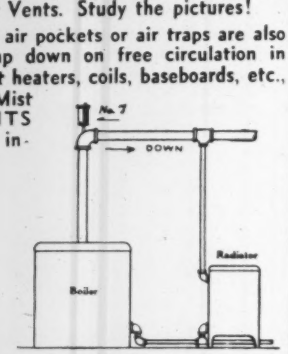


Automatically venting out air from hot water unit heater.

And Note Other "Spots" Where AUTO-VENTS Protect Your Reputation

Circulation "troubles" of many different kinds can be overcome by using these low priced Automatic Air Vents. Study the pictures!

Yes, wherever air pockets or air traps are also likely to clamp down on free circulation in pipe lines, unit heaters, coils, baseboards, etc., Maid-O'-Mist AUTO-VENTS should be installed.



Automatically venting out air from overhead hot or cold water lines.

We have three types—for pressures to 75 lbs.

TODAY write for complete Maid-O'-Mist data and attractive prices, or see your jobber.

MAID-O'-MIST INC.

3215 N. PULASKI RD.
CHICAGO 41, ILLINOIS

AUTOMATIC HUMIDIFIERS FOR ALL TYPES OF HEATING SYSTEMS

EXECUTIVE CHANGES

A. C. Monteith, 46-year-old engineering executive of Westinghouse Electric Corp., has been elected vice president in charge of engineering and research. He succeeds Marvin W. Smith whose election as executive vice president of Baldwin Locomotive Works has been announced.

Stephen J. Daly has been named advertising manager of Owens-Corning Fiberglas Corp. He will manage the company's advertising activities under the direction of E. C. Ames, director of advertising.

F. E. Lehman, manager of the sales and service department, Aeroproducts Div., General Motors Corp., is now assistant commercial sales manager of the company's Frigidaire division. He succeeds A. C. Freimann who has been appointed general sales manager of the Delco Appliance division.

Allis-Chalmers Mfg. Co. has appointed W. L. Manly manager of dealer sales, succeeding W. A. Meyer who has been named assistant manager of the company's "Texrope" Drive dept. T. J. Hodan succeeds Mr. Manly as manager of the water conditioning department.

The new manager of sales for Minneapolis-Honeywell Regulator Co. products for industrial applications is Ray R. West. According to company officials, Mr. West's appointment is in line with current sales expansion and new products developments in industrial and specialized fields. L. E. Slater has been appointed industry engineer in charge of food industry applications for measuring and controlling devices made by Brown Instrument Co. Div. and Minneapolis-Honeywell.

Parker F. Wilson has been elected president and director of the Kerotest Mfg. Co. Former president Walter G. Swaney has been named vice chairman of the board. Mr. Wilson has been a familiar figure in steel circles for more than 20 years.

Directors of the Pyle-National Co. have elected Durward I. Packard vice president in charge of sales. During the war he was with the War Production Board and has long been associated in the railroad industry.

Charles J. Wurmfeld and Eric Singleton have resigned from the engineering firm of Gibbs & Cox to open their own consulting engineering offices at 150 Nassau St., New York City. Mr. Wurmfeld has specialized in the design of heating systems for over 20 years. While with Gibbs & Cox he was in charge of the steam heating on naval vessels and liberty ships. Mr. Singleton was associated with him for six years in the hull piping department and on factory design and prior to that had extensive experience as a builder.

Carl A. Sawade has been appointed eastern district sales supervisor for both Dunkirk Radiator Corp. and Utica Radiator Corp. For the past several years he has been vice president in charge of sales for Dunkirk and prior to that held a similar position with Utica. These two companies are separate concerns, but because of geographic location and the fact that the products of one complement those of the other, it has been found feasible to combine selling efforts.

J. H. Williams & Co. has opened a warehouse and sales office in Los Angeles. A complete stock of the company's products including drop forgings and drop forged tools will be carried to serve the western area. Charles F. Coates has been appointed western district manager in charge of this new office and warehouse.

Tuthill Pump Co. has appointed E. W. Chapman vice president in charge of engineering. He is well known in the industry for his wide experience in the rotary pump field.

Minneapolis-Honeywell Regulator Co. has formed a new department to supervise and coordinate the advertising, merchandising, and sales promotion activities of the company. John R. Bergan has been appointed head of the new department as merchandising manager. Other changes include the promotion of Chandler Murphy as advertising manager and John A. Young as sales promotion manager.

Bastian-Morley Co., Inc., has named F. M. Pain as sales manager. He is well known in the industry and has a record of 20 years of sales background with water heaters.

A. H. Graham is now manager of General Electric's D-c Armored Motor Engineering Division, Small and Medium Motor Divisions, Erie works. He joined the company in 1939 and has worked on the design of traction generators and motors, propulsion motors, and generators for diesel-electric powered mine-sweepers, net tenders, and fleet tenders. He has been involved with the design and development of generators for use on diesel-electric road locomotives, motor-generator locomotives, and the experimental gas turbine locomotive.

John Druml and Samuel W. Ouweneel have been named chief inspectors of the general machinery and tractor divisions respectively of Allis-Chalmers Mfg. Co. They succeed G. William Warner, retired.

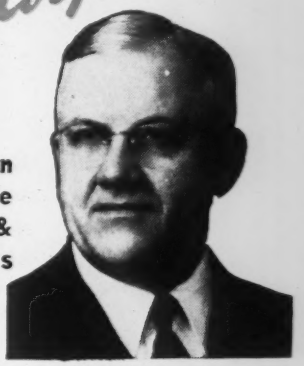
Rowland J. Miller, formerly general sales manager for appliances, Ohio Fuel Gas Co., has become associated with Clayton & Lambert Mfg. Co. as special assistant to Charles F. Lambert, president.

Eutetic Welding Alloys Corp. has announced the appointment of G. Luke Mizell to the board of regional sales supervisors. He has been a company field engineer, senior field engineer, and regional sales supervisor.

FOR

Quality Products
Prompt Service
Profitable Cooperation

Buy from a Herman Nelson Distributor like Globe Machinery & Supply Co. of Des Moines, Iowa.



C. W. Helstrom,
Vice-President-Manager,
Globe Machinery & Supply Co.,
Des Moines, Iowa

The Herman Nelson Corporation and its carefully selected Distributors, like Globe Machinery & Supply Co., are rightfully proud of the reputation they have established in the heating and ventilating industry. This reputation is based on a Herman Nelson policy established 42 years ago . . . that nothing less than top-quality products, reliable service and intelligent cooperation can be acceptable.

The Products? Thousands of satisfied owners all over America have learned through actual experience that you can't buy better heating and ventilating equipment than that bearing the Herman Nelson nameplate.

Service? Prompt delivery of Herman Nelson products is assured through aggressive Distributors who stock both the equipment and materials required for installation.

Cooperation? Timely sales promotion and comprehensive engineering data, furnished by Herman Nelson, provide that extra spark that leads to more profits for you as a dealer.

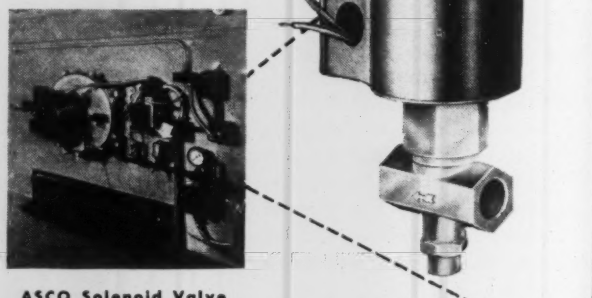
Quality products, prompt service and intelligent cooperation — these are the keys to increased business. You'll find them all at your nearest Herman Nelson Distributor.

Herman Nelson Vertical Shaft Propeller-Fan Type Unit Heaters
Part of Herman Nelson's
QUALITY LINE
of Heating and Ventilating Equipment
Herman Nelson Horizontal Shaft Propeller-Fan Type Unit Heaters

THE HERMAN NELSON CORPORATION
Since 1906 Manufacturers of Quality Heating and Ventilating Products
MOLINE, ILLINOIS

ASCO SOLENOID VALVE
BULLETIN 8281

Combination
Metering and Shut-Off Valve
for Industrial Oil Burners



ASCO Solenoid Valve Bulletin 8281 as incorporated in a well-known oil burner assembly.

This Bulletin 8281 ASCO Solenoid Valve takes care of two essential oil burner requirements: (1) provides the automatic control of the flow of oil as determined by thermostat or other device: (2) effects instant and complete stoppage of the flow of oil should an emergency require instant shut-down of the burner. It is a "packless" type of needle Shut-Off Valve, available in 3/8" and 1/2" pipe sizes only. It is equipped with manually adjustable main flow. A similar valve with adjustable by-pass for industrial oil burners is available.

Designing and manufacturing solenoid valves has been our business for many years. We are at your service . . . to help select the proper control valve for your requirements from the many standard valves available or to design a new type valve should that be necessary.

ASCO Solenoid Valves

When in need of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Specialized Electromagnetic Controls, come to us.

Automatic Switch Co.
389 Lakeside Avenue Orange, New Jersey

Executive Changes (Cont.)

The appointment of Gordon E. Garnhart as director of the real estate and insurance division of Westinghouse Electric Corp. has been announced. He joined the organization in 1927 as a member of the student training course and has served in various engineering, purchasing, and accounting department positions.

J. J. Topolinski, works manager of Skilsaw, Inc., has been elected vice president in charge of manufacturing. He has been with the company since 1932, having been successively production manager, superintendent and, since 1943 works manager. Walter W. Kemphert has been named vice president in charge of sales.

John R. Swikard is the new plant manager for the Schaible Co., according to a recent announcement. He graduated from the University of Southern California in mechanical engineering.

Dr. Richard C. Hitchcock, who has spent over 30 years in laboratories and on the lecture platform, has been appointed as science lecturer for Westinghouse Research Laboratories. He will tour the nation with special science shows designed to make the latest scientific advances understandable to all.

Paul B. Reed, manager, refrigeration controls division, Perfex Corp., has been appointed full time educational director of the Refrigeration Service Engineers Society. This appointment is said to be part of a long range plan to expand and intensify the services offered by the society to its members and to more effectively correlate its activities with other industry groups. He has been active for a number of years in the educational work of the society, is a past chairman of the Milwaukee section of the American Society of Refrigerating Engineers, and has served on several ASRE national committees. He is also the author of several texts and a number of articles published in trade periodicals.

Provides More Uniformity in Marine Pipe Welding Rules

By publication of its new Rules for Welding Piping in Marine Construction (Carbon Steel Only) the American Welding Society has endeavored to effect a uniformity in the classification and basic welding requirements of the governing agencies in the shipbuilding industry.

In this new edition, two important factors have been revised and clarified; materials and classification of piping. The classification changes have been made to conform more closely to the requirements for stationary piping and have been broken down into more specific groupings.

Copies of this five page, paper covered booklet, identified as D3.3-48, can be obtained from AWS headquarters, 33 W. 39th St., New York 18, for 25c each.

NEW BOOKS & REPORTS

Proposes Standards for Weight And Dimensions of Stainless Pipe

The more recent developments of the highly alloyed stainless steels, the fact that thin walled stainless piping systems may be designed without fear of early failure due to corrosion, and improvements in the art of fusion welding are some of the factors which have led to the formulation of the new proposed American Standard, Stainless Steel Pipe, ASA B36.

Sponsored by the American Society for Testing Materials and the American Society of Mechanical Engineers, the standard lists dimensions of welded and seamless, stainless pipe. Nominal weights are also covered. Wall thicknesses shown for schedules 40S and 80S are identical with those of schedules 40 and 80 in the standard ASA B36.10, except in the 12 in. size in schedule 40S and the 10 and 12 in. sizes in schedule 80S. Thicknesses for these three sizes correspond to the wall thicknesses of standard wall and extra strong wall. In the proposed standard, the wall thickness dimensions shown under schedule 10S are based on the conventional formula but have been modified to correspond to the nearest B.W. gage number.

In these new pipe standards, the word "pipe" is used as distinguished from tubing, restricting the term pipe and therefore the scope of the standards to tubular products, dimensions, and materials commonly used in pipe lines and connections. The dimensional standards for pipe described are based on materials as covered in ASTM specifications A-158 and A-312.

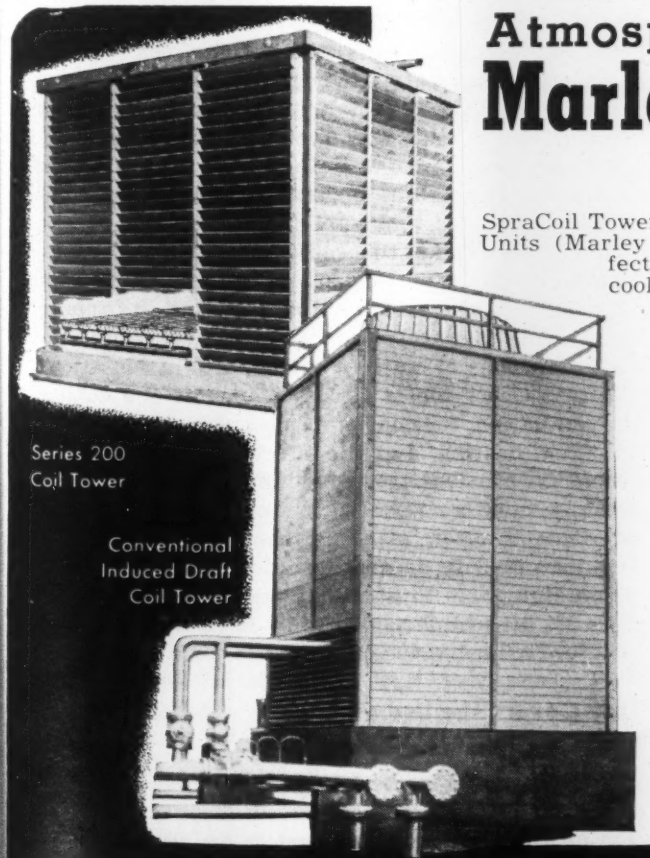
In addition, it is to be noted that "when the selection of wall thickness depends primarily upon capacity to resist internal pressure under given conditions, the designer shall compute the exact value of the wall thickness suitable for conditions for which the pipe is required as prescribed in detail in the ASME boiler code, American Standard Code for Pressure Piping (ASA B31.1), etc., whichever governs the construction."

This three page, proposed standard, which has been printed by the ASME, 29 W. 39th St., New York City, is at present a tentative draft and subject to revision.

Finds Cottonseed Hulls Have Insulating Value

Cottonseed hulls have an average conductivity value, k, of 0.38 Btu per hr per in. thickness per sq ft per deg in the temperature range of 80 to 100 F, according to a report, Cottonseed Hulls as an Insulating Material, by W. E. Long, professor of mechanical engineering, A. & M. College of Texas.

Test results, obtained by the shielded box method, are also said to indicate that the value of k within the lower temperature range, say for medium and low temperature refrigeration, would be lower and would make this material competitive with other standard loose fill insulations so far as insulating effectiveness is concerned. All tests were made with an average hull density of approximately 10.6 lb per cu ft. Other conclusions of the report: lint content, within reasonable



Atmospheric and Induced Draft

Marley SpraCoil Towers

FOR CLOSED SYSTEM COOLING OF LIQUIDS, OILS AND GASES

SpraCoil Towers are the logical combination of two service-tested Marley Units (Marley Towers and Marley atmospheric sections) into one perfectly coordinated installation. For indirect and combination cooling, SpraCoil Towers set performance standards in a wide range of plants. For years they have rendered the ultimate in service for:

DIESEL PLANTS — Cooling jacket water and lube oil.
CHEMICAL AND FOOD PROCESSING — General process cooling.
DAIRIES — Cooling milk.
REFINERIES — Cooling or condensing oil, water and volatiles.
FOUNDRIES — Cooling quenching oils.

. . . also in . . .

Recycling and Natural Gasoline Plants, Compressor Stations, Smelters and Mines

The Marley Double-Flow Tower with the Marley coil shed also is adapted to high-efficiency coil cooling for largest installations.

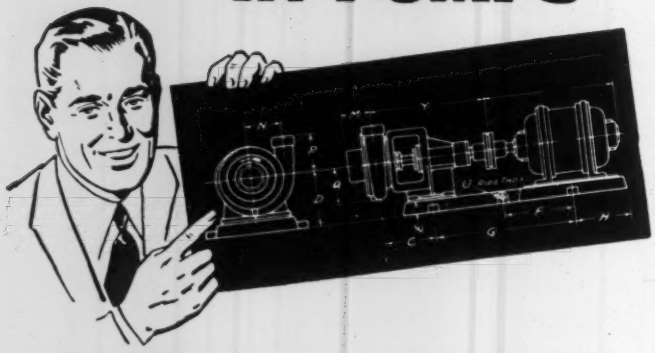
THE MARLEY WAY is the PERFECT SPRAY

Marley Non-Clog Spray nozzles boost efficiency in any cooling unit. For peak performance modernize present equipment with these patented nozzles.

MARLEY COOLING TOWERS

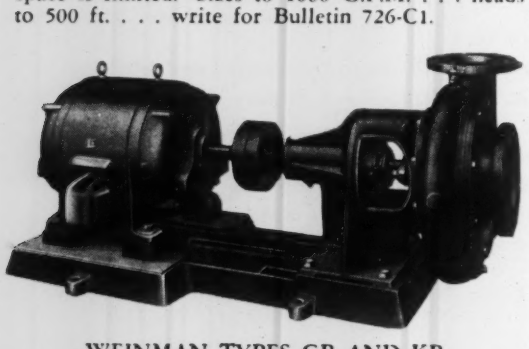
THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

"Career Men IN PUMPS"



● *Every* key man in the Weinman organization from General Manager to Foremen in all Departments,— Design,— Engineering,— Pattern,— Foundry,— Tool Development,— Machine Shop,— Assembly Line,— Testing,— Shipping,— Sales,— has had at least twenty-five years of concentrated experience with *one* product — PUMPS. Whatever your fluid handling problems may be, it will pay you to talk with Weinman. This consultation is free for the asking . . . write, wire or phone.

WEINMAN GENERAL SERVICE UNIPUMP
May be mounted in any position . . . for use where space is limited. Sizes to 1000 G.P.M. . . . heads to 500 ft. . . . write for Bulletin 726-C1.



WEINMAN TYPES GB AND KB CENTRIFUGAL PUMPS
Side suction . . . discharge opening may be put in any one of 4 positions. For capacity and head selection, write for Bulletin 727-B.

Built by Centrifugal Specialists
The WEINMAN Pump Mfg. Co.
284 Spruce Street • Columbus 8 • Ohio

limits, has no affect on thermal conductivity and the primary insulating quality is obtained from the numerous air cells formed by the configuration of the particles of the mass of hulls. All data were obtained on untreated hulls and no conclusions can be drawn from the report in regard to the effect of fire, water or rodent-proofing treatment.

Published in the form of a paper coverd 8½ x 11 in. mimeographed booklet, this 12 page report is identified as Research Report No. 2 of the Texas Engineering Experiment Station, Agricultural and Mechanical College of Texas, College Station, Tex. It is the result of a cooperative investigation sponsored by the Cotton Research Committee of Texas.

Summarizes Basic Principles of Heating and Ventilating

In his new text on the Basic Principles of Ventilation and Heating, Dr. Thomas Bedford deals with the subject in terms of basic human needs. No attempt has been made to give a detailed treatment of engineering practice, for (as the author says) many works on engineering aspects are available. His discussion of fundamental principles should be of interest to engineers, architects, public health officials, and others concerned with the control of environment.

It should be remembered that the author, a member of the scientific staff, Medical Research Council, and an honorary member of the Institution of Heating and Ventilating Engineers, is English and that many of his remarks reflect the current thinking and practices in his country. For example, in discussing heating with floor panels he says that the surface temperature of the floor should not exceed 75 to 80 F for higher floor temperatures tend to be "very tiring to the feet". In regard to effective temperatures, he points out that the range recommended for British subjects is from 57 to 63 deg and that this is distinctly lower than found desirable for Americans and Canadians. Inasmuch as a rather large amount of heating in England is accomplished by the use of open fireplaces and solid fuel burning stoves, a chapter is devoted to this subject.

Major emphasis of the book is on subjects such as heat transmission, thermal environment and its measurement, scales of warmth, body heat production and heat loss, sensations of warmth and cold, and sensations of comfort. Other topics discussed include the quality of air, ventilation, thermal properties of buildings, air conditioning, heating, and the effects of atmospheric conditions on accident frequency and sickness. The works of many American investigators are frequently cited and reference is often made to papers published by the American Society of Heating nd Ventilating Engineers.

Containing 123 illustrations and 402 + x pages, this 5½ x 8¼ in. book is published by H. K. Lewis & Co., Ltd., 136 Gower St., London, W.C.1. The price is 25s.

Text Covers the Use of Molybdenum for Alloying

A wide range of materials from wrought to cast steels and from cast iron to nonferrous alloys is covered in a text on the use of molybdenum as an alloying element. Molybdenum, Steels, Irons, Alloys, by R. S. Archer, J. Z. Briggs, and C. M. Loeb, Jr., gives a good deal of informa-

tion on the many varied applications, with major emphasis on the fundamentals which guide engineers, designers, and metallurgists in the selection of the most suitable materials for a given application.

An attempt has been made to show the similarity and dissimilarity of the various materials and to indicate some of the factors affecting the choice of material. Considerable recent information is included, not only on the more prominent developments such as the gas turbine steels and alloys, but also on the work that has served to clarify the factors affecting the service life of the lower alloy steels. The appendices include data on standard compositions of American, British, and French engineering steels, allowable working stresses as set forth in the ASME boiler code, conversion factors, and the physical properties of metallic molybdenum.

This clothbound text, containing 391 pages, 188 illustrations, and 91 tables, is published by the Climax Molybdenum Co., 500 Fifth Ave., New York 18. It is being distributed, free of charge, to metallurgists and others closely connected with the metallurgical industries.

ASRE Issue Data on Air Conditioning For Storing Lemons, Grapefruit

Refrigeration of Lemons and Grapefruit is the title of the latest brochure published by the American Society of Refrigerating Engineers.

The 10 page pamphlet, known as AD-18 R, describes handling methods, coloring process, storage methods, air conditioning equipment, diseases, air distribution, etc. This application data sheet is a completely revised edition of the similar data published in 1940. The authors are H. M. Hendrickson, chief engineer, Ralph E. Manns Co., Los Angeles, and J. R. MacRill, field service and research dept., California Fruit Exchange.

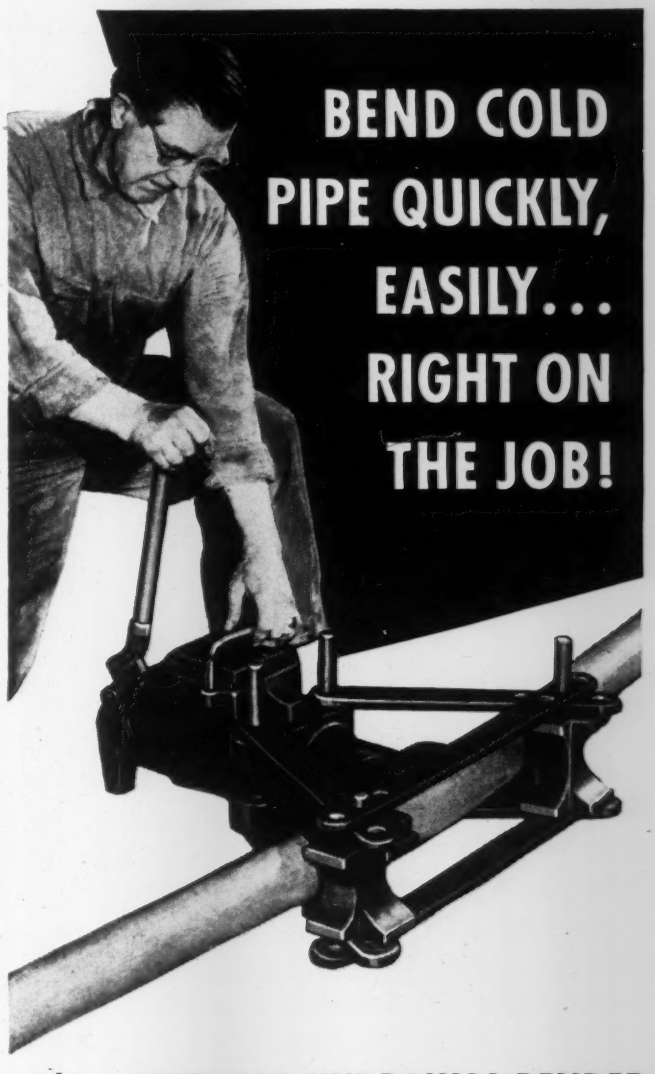
Copies may be obtained from ASRE headquarters at 40 W. 40th St., New York City, for 50c each.

Other Books and Reports Received

Standard Code for Testing and Rating Unit Heaters Using Hot Water up to 200 F Flow Temperature, published by the Unit Heater Manufacturers' Association, 23 Queen Sq., London, W.C.1., 3/6 net, 3/8 post free. Published in the form of a 16 page, paper covered booklet, this British code was prepared by the association and becomes effective next January.

Bibliography on Industrial Radiology, 1945-48, by Herbert R. Isenburger, lists some 330 odd technical papers and reports and, according to the publisher, St. John X-Ray Laboratory, Califon, N.J., is a second addenda bringing the bibliography up to date. The first part, up to 1942, appeared in Industrial Radiology, published in 1942 by John Wiley & Sons and the first supplement, 1942-45, was published by the laboratory. The price of the second supplement is $2.00.

1948 Store Modernization Clinics, published by the Store Modernization Show, 40 E. 49th St., New York 17, $5.00. Store layout and traffic, lighting and color, store fronts, and planning and budgeting for modernization are some of the subjects covered by leading authorities.



with a GREENLEE HYDRAULIC BENDER

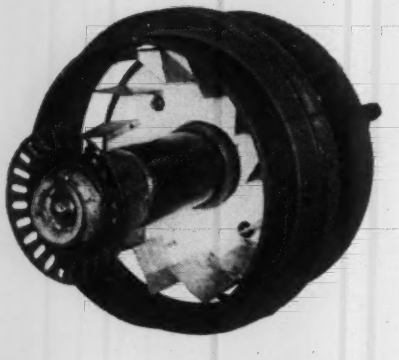
Yes, make pipe bends "right on the job" . . . exactly where and when you need them! And do the job swiftly, accurately with a GREENLEE Hydraulic Pipe Bender.

Bends pipe up to 4½". Simple to operate, easy to carry, set up and shift from job to job. With a GREENLEE *one man* makes smooth, precise, uniform bends in but a few minutes. Speeds your piping installations, cuts costs on labor and materials. In timesavings alone, the GREENLEE pays for itself quickly.

Ideal for radiant heating jobs, too. For complete details write for free Bender Booklet E-201. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2350 Twelfth Street, Rockford, Illinois.

TOOLS FOR CRAFTSMEN
GREENLEE

JOHN ZINK BURNERS For INDUSTRIAL and COMMERCIAL BOILERS

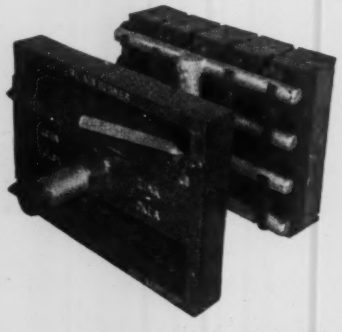


The New "Y" Combination Oil & Gas Burner

Fuel scarcity is no problem if you use John Zink Series "Y" Burners because this burner burns either, or both, gas and oil with the same heat pattern.

- **Independently removable fuel guns.**
- **Uninterrupted Burner service.**
- **Easy to remove fuel guns—Feather weight type, one man can remove for inspection and cleaning while the boiler remains in service.**
- **Easy to operate.**
- **Simple in construction.**

Series "R" Bi-Air Burner



For all types and sizes HEATING BOILERS and small Power Boilers—JOHN ZINK offers the Series "R" Bi-Air short flame, Gas Burner with Multi-jet burners, having refractory semi-venturi mixing throats, with a separate gas orifice to each throat. Capacities to meet your requirements.

Especially adapted for installing in boilers having very low draft and small combustion space.

— Write for Literature —

John Zink Company

4401 South Peoria

TULSA, OKLAHOMA

New York - Salt Lake City - Houston - Los Angeles

MEETINGS & CONVENTIONS

American Chemical Society, Chicago section, 1505 S. Wabash Ave., Chicago 5—Fifth National Chemical Exposition, October 12 through 16, Chicago Coliseum.

Plans for this show include the revival of the National Industrial Chemical Conference, which was not scheduled at the last show held in 1946.

According to Dr. L. E. Clifcorn, chairman of the exposition committee, the conference will feature noted speakers who will present 21 technical papers on new developments, discoveries, and applications in industrial chemistry. All sessions will be held in the Coliseum and all show visitors are welcome to attend the conference.

According to Marcus W. Hinson, show manager, the exposition, which will be open from noon to 10 p.m. daily except the closing day when it will run from 10 a.m. to 6 p.m., will appeal to chemists, engineers, production managers, plant superintendents, and others interested in new developments in the industry. Exhibit space has been assigned to more than 200 firms.

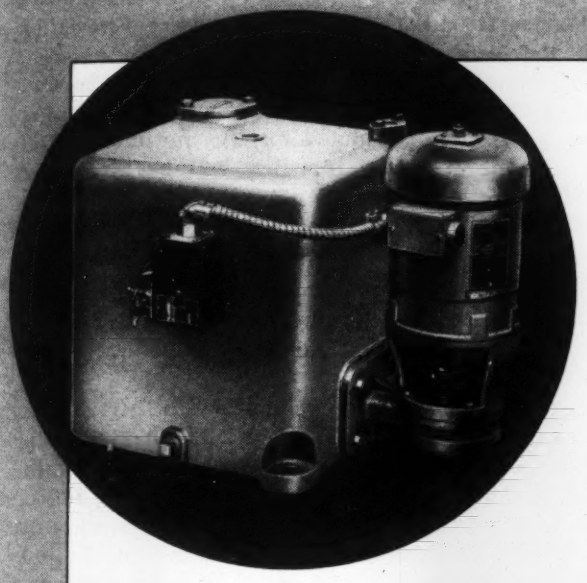
National Association of Housing Officials, 1313 E. 60th St., Chicago 37—annual meeting, October 13-16, Olympic hotel, Seattle. The Third Annual Exhibit of Building and Maintenance Products will be held concurrently.

National Institute of Governmental Purchasing—third annual conference and exhibit, October 18 to 20, Bellevue-Stratford hotel, Philadelphia. President W. Z. Betts, director of the division of purchase and contract, State of North Carolina, will be assisted by a committee of governmental buyers and a committee from the ranks of exhibitors. Executive director of the institute is A. H. Hall, 730 Jackson Pl., N.W., Washington 6, D.C.

Thirty Sixth National Safety Congress and Exposition—sponsored by the National Safety Council, 20 N. Wacker Dr., Chicago 6, Ill. This event will be held October 18 to 22 and five hotels will house the safety sessions and expositions. The industrial safety exposition and industrial sessions will be held at the Stevens; industrial, school, and college sessions at the Morrison; and other industrial sessions at the Congress and La Salle hotels. The public safety exposition will be at the Sherman hotel.

Nearly 10,000 persons are expected to attend the 200 sessions on all phases of safety. A labor-management session will bring together representatives of the C.I.O., A.F. of L., and industrial management in a discussion of safety responsibilities and methods.

Plumbing and Heating Industries Bureau, 35 E. Wacker Dr., Chicago 1—annual meeting, the afternoon of October 21, Palmer House, Chicago. All manufacturers, wholesalers, and contractors who are interested in consumer publicity are invited to the meeting.



THE LITTLE CONDENSATE RETURN PUMP

that does a

BIG JOB

CONDAFLO

A NEW AMES ACHIEVEMENT

Here is a completely packaged, stream-lined pump incorporating advanced engineering principles. Occupying only 18" x 24" of floor space, it performs quietly and efficiently. Without any mechanical adjustment this pump will range from 500 to 8000 sq. ft. EDR. Capacity—12 gpm at maximum discharge. Discharge pressure—20 lbs. psi. Designed and built to meet the rigid specifications of the heating engineer.

Write to Dept. H for FREE catalog.

"If it's a job for a pump—it's a job for Domestic"

DOMESTIC ENGINE & PUMP COMPANY

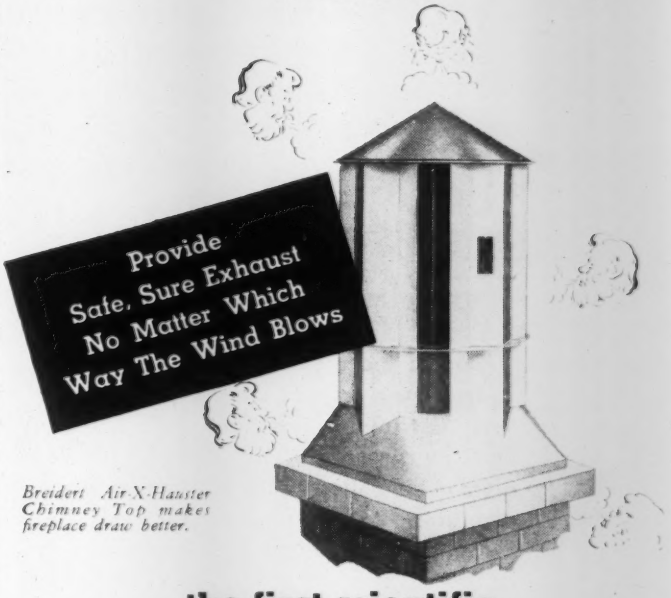
A Division of Empire Industries, Inc.

SHIPPENSBURG • PENNSYLVANIA

ON CHIMNEYS AND VENT FLUES

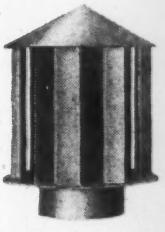
Breidert Air-X-Hausters

(PAT. NO. 2269428)



Breidert Air-X-Hauster Chimney Top makes fireplace draw better.

the first scientific improvement in roof ventilators in over 50 years!



Type B Breidert Air-X-Hauster for factories, commercial and residential buildings.

No matter which way the wind blows, no matter how bad the weather—the Breidert *provides positive exhaust.* Designed in accordance with the science of aerodynamics, this revolutionary ventilator utilizes the power of air currents coming from *all angles* to provide safe, positive ventilation without back-draft. Stationary—no moving parts to regulate or get out of order.. no power consumption... compact and pleasing in appearance.

Breidert Air-X-Hauster—the first ventilator to be tested under all variable vertical and horizontal wind conditions . . . with certified ratings published.

Unlike most conventional ventilators which work efficiently only when wind strikes in a horizontal plane, the Breidert has been thoroughly tested—by U. S. Navy and Smith Emery Commercial Testing Laboratories—with the wind blowing in *all* directions. Its remarkably high performance ratings under all conditions are *certified and published.*

Many Thousands in Use all over the Country

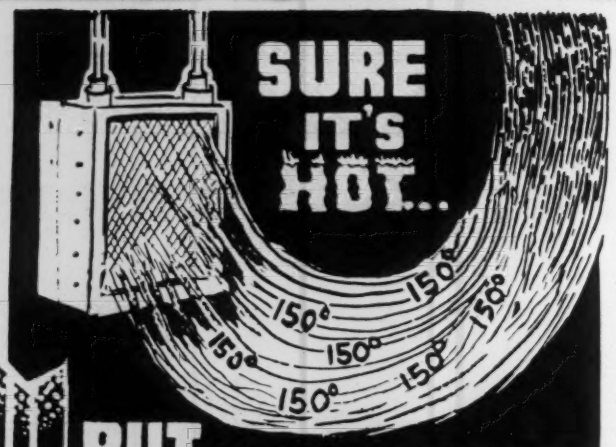
Breidert Air-X-Hausters have found wide acceptance among architects, engineers, industrialists, farmers, home owners, ship and boat owners. U. S. Army, U. S. Navy, Maritime Commission, schools, institutions and public buildings. In every case when properly installed, the Breidert has never failed to fully meet every claim made for it!

Free Engineering Data Book, with complete specifications, sent on request. Address

"Ask to see this interesting demonstration"

G. C. BREIDERT CO.,
3129 SAN FERNANDO ROAD
LOS ANGELES 41, CALIFORNIA

Representatives in 50 principal cities throughout the United States

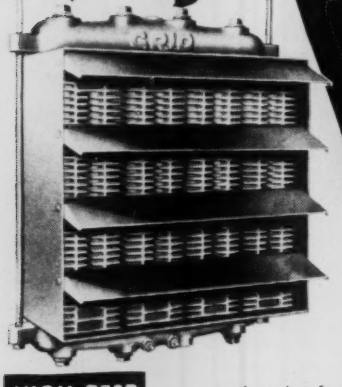


BUT WHAT GOOD IS IT AT CEILING LEVEL?

Do you spend your heating dollars only to heat your ceiling? Or, do you want the very most from your heating dollar? If so, don't be confused by unit heaters offering great BTU delivery and high outlet temperatures. Any unit heater that fails to deliver warm air to the floor level where it is needed most is simply spending your heating dollars to heat that part of your building that does not require heating.

BTU Rating in a unit heater does not mean everything. It is the CFM and outlet temperature that really does the job.

INVESTIGATE GRID UNIT HEATERS



Investigate GRID Unit Heaters that are designed for low outlet temperature and greater air delivery. They are constructed to deliver warm air in greater volume to the working zone where it is needed . . . resulting in saving in fuel consumption, assuring the very ultimate from your heating dollar.

GRID heating sections are one piece construction high test cast iron—the metal for permanency . . . no electrolysis because there are no dissimilar metals used in GRID construction. Hence, no maintenance expense—but years of trouble-free heating service.

HIGH TEST CAST IRON HEATING SECTIONS

D. J. MURRAY MANUFACTURING CO.
WAUSAU WISCONSIN

Meetings & Conventions (Cont.)

Refrigeration Equipment Manufacturers Association and the **Refrigeration Equipment Wholesalers Association** — a joint meeting to be held October 21 to 23, French Lick, Ind. Talks and discussion periods on problems affecting both groups are scheduled for the morning of October 22 and the following morning will be given over to product section meetings. For additional information write REMA at 3751 Prospect Ave., Cleveland.

American Welding Society, 39 W. 39th St., New York City—annual meeting, October 24-29, Bellevue-Stratford hotel, Philadelphia.

Inert gas-shielded arc welding will be given considerable attention as two of the many technical sessions will be devoted to this subject. A paper on pipe welding, by John H. Zink, president, Heat & Power Corp., Baltimore, will be presented during the session on storage tanks, pressure vessels, and piping.

The concurrent National Metal Exposition will be held in the Commercial Museum and convention halls. The first educational lecture series will be given by Dr. R. D. Stout, department of metallurgy, Lehigh University. His three lectures will be on the metallurgy of arc welds in steel.

Third Annual Short Course in Instrumentation for the Process Industries—offered by the Agricultural and Mechanical College of Texas, October 26 to 28. The course will be conducted as a seminar with lectures and discussions on the subject of automatic control. Lectures will cover the measurement and control of temperature, pressure, liquid level, as well as time control and other allied subjects.

Anyone living either in or outside of Texas is eligible to take the course on payment of a $5.00 registration fee. Rooming accommodations and meals will be available on the campus and further information may be obtained from Prof. P. G. Murdoch, chemical engineering department, Texas A & M College, College Station, Tex.

Refrigeration Service Engineers Society, 433 N. Waller Ave., Chicago 44—11th annual convention, November 19 to 22, Hotel Sherman, Chicago. The third annual regional educational exhibit, sponsored by the Refrigeration Equipment Manufacturers Association, will be held in conjunction with the meeting and the 125 exhibits will occupy the mezzanine floor of the hotel. Reservation forms which have been sent to members will be honored by the official hotel only if received before October 17.

American Society of Refrigerating Engineers, 40 W. 40th st., New York City—1948 annual meeting. December 5 to 8, Hotel Statler, Washington, D. C.

The technical program will be under the supervision of C. M. Ashley, chairman of the program committee, and W. S. Woodside will be the convention chairman.

Meetings & Conventions (Cont.)

National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14—35th annual convention, Hotel Cleveland, Cleveland, December 9 and 10. Current problems and the industry's overall objectives will highlight the meeting.

Ninth International Heating, Ventilating, and Air Conditioning Exposition, January 24 to 28, International Amphitheatre, Chicago—under the auspices of the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City.

Under the management of the International Exposition Co., Grand Central Palace, New York 17, this event will be the largest of its kind ever held, according to Charles F. Roth, show manager.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City—the 55th annual meeting, January 24 to 27, 1949, Stevens hotel, Chicago.

The Illinois Chapter will be host for the occasion and W. A. Kuechenberg is in charge of arrangements.

Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago—plans have tentatively been made to hold a one day membership conference in Chicago during the last week in January.

American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa.—the following 1949 meetings have been scheduled:

Spring meeting and ASTM committee week, Edgewater Beach hotel, Chicago, February 28 to March 4.

Fifty-second annual meeting, Chalfonte-Haddon Hall hotel, Atlantic City, June 27 to July 1.

First national meeting of the society on the west coast, Fairmont hotel, San Francisco, October 10 to 14.

American Foundrymen's Society, 222 W. Adams St., Chicago—1949 annual meeting, May 2 to 5, St. Louis, Mo.

Oil-Heat Institute of America, 6 E. 39th St., New York City—1949 national convention and industry exposition, the week of May 16, Boston. The convention committee has approved Mechanics Hall for the exposition and the Statler as the headquarters hotel.

American Society of Refrigerating Engineers, 40 W. 40th St., New York City—Proposed 1949 Spring meeting, June 5 to 8. As tentatively planned, the technical sessions and committee meetings will be held aboard ship and will be combined with a cruise, from Montreal, on the St. Lawrence and Saguenay rivers. Stops for sightseeing will be made at Murray Bay, Tadoussac, and Quebec.

Sixth **All-Industry Refrigeration and Air Conditioning Exposition,** the week of November 14, 1949, Atlantic City —sponsored by the Refrigeration Equipment Manufacturers Association, 1107 Clark Bldg., Pittsburgh 22, Pa.

PERFECT THREADS
in a jiffy
ON 1" TO 2" PIPE

RIDGID No. 65R
adjusts to pipe size in just ten seconds

• RIDGID No. 65R threads any 1", 1¼", 1½" or 2" pipe with surprisingly little effort. You set it to size in just 10 seconds, workholder sets instantly; only one screw to tighten, no bushings. One set of high-speed steel chasers stay in die stock—no extras to haul around or lose. Every 65R is factory-tested. It won't take you long to see why this rugged work-saver is the favorite of pipe experts. It pays you to buy No. 65R—at your Supply House.

No. 65R stands on its own feet ready for instant use.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 181. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Air Dryers

No. 6992—The third in a series of data sheets (Datagram SGD 3) has been released by Bryant Heater Co., Industrial Div., 1020 London Rd., Cleveland 10. Dealing with independent control of humidity and temperature in the basic air conditioning system, the data sheet covers the application of the company's dryers to industrial process and comfort conditioning.

Arc Welding Electrodes

No. 6993—A 40 page electrode catalog has been published by the Wilson Welder and Metals Co., Inc., 60 E. 42nd St., New York 17. The catalog contains 50 photos and diagrams, an electrode selector chart, and complete details on all the electrodes in the company's line.

Blower Wheels and Blower Assemblies

No. 6994—Blower wheels of both the single and double inlet types and centrifugal blower assemblies are the subject of a new folder issued by Burden Co., 1000 N. Orange Dr., Los Angeles 38. The aluminum blower wheels are of the forwardly curved blade type. According to the company, a patented construction method is used wherein special machine tools produce a louver strip of blades. A machine then applies and locks end rings and louvers in one operation.

Central Heating in Housing Projects

No. 6995—Housing America is the title of a 27 page booklet, one of a series of project studies involving central heating, published by Ric-wiL Co., Union Commerce Bldg., Cleveland 14. "In the interests of more and better housing," the booklet discusses present and future housing requirements, the present shortage and its underlying causes, and suggests corrective measures. The development of row-house type communities is featured and emphasis is placed on the advantages of central heating. An appendix gives details on several large scale and well known rental projects sponsored by insurance companies.

Condensate Return System

No. 6996—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia 32, has announced the publication of a four page specification bulletin (No. 3250-1) on the new CBA high differential, high pressure condensate return systems. In addition to material and operating specifications, capacity ratings are given for the six different sizes available (3, 5, 7½, 10, 15 and 25 hp). The ratings are based on a maximum of 200 psi pressure differential. According to the company, the new system is designed to return condensate to the higher pressure boilers from

Where quarters are close . . . . . .

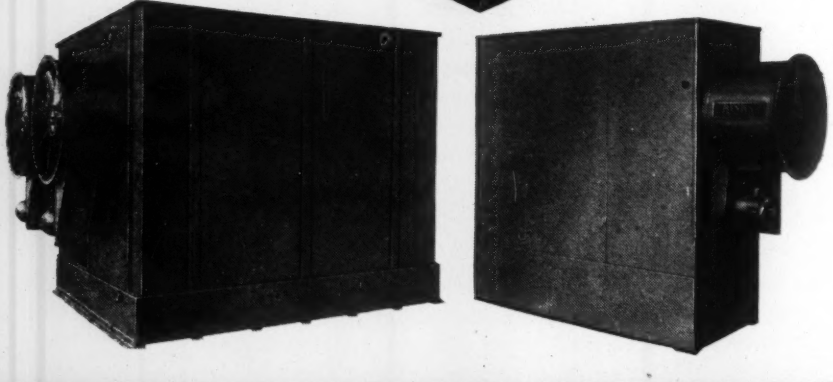
BINKS Horizontal Induced Draft Cooling Towers

create their own air movement!

Binks

Send today for Bulletin No. 33 (describing single fan) or Bulletin No. 34 (describing twin fan) Horizontal Induced Draft Cooling Towers. Contain charts, dimensions and other data to help you choose the right Binks Type 2-D Units. State tower capacity required.

Binks Type 2-D Horizontal Induced Draft Cooling Towers are standard where natural air movement is restricted. They create their own draft for efficient operation . . . can be operated indoors or outdoors. Engineered to give many years of trouble-free service, these modern, compact units are available in a wide variety of standard sizes and capacities. Provide maximum cooling at lowest possible cost . . . you can use the same cooling water over and over. Highly efficient for cooling circulating water for refrigeration and air conditioning condensers. Also suited to a wide variety of industrial processes where heat is liberated to circulating water.

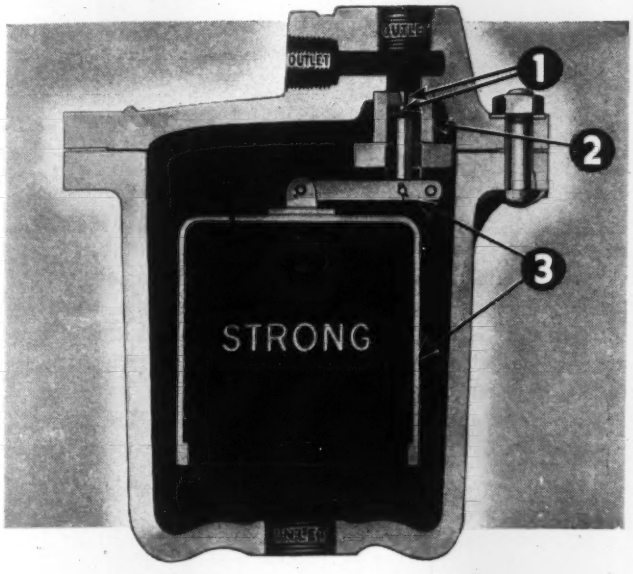


THERE'S A BINKS TOWER FOR EVERY COOLING JOB

Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3118-38 Carroll Avenue, Chicago, Ill.

3 Reasons STRONG* Traps are easy to maintain!



Look for these three STRONG low-maintenance features in the STRONG 80 Series Inverted Bucket Trap:

1. **Anum-Metl Valve and Seat—guaranteed leakproof for one year;**
2. **Bolted-in seat design—insures tight seal, easy servicing;**
3. **Stainless steel bucket and trim.**

Compare these features with other traps!

STRONG 80 Series Trap sizes ½" to 2½", pressures to 250 lbs., temperature to 500° F. (forged steel for higher pressures).

Dual outlet simplifies piping, bottom inlet keeps trap cleaner. Years of trouble-free operation assured by super-STRONG construction.

Catalog No. 67 describes inverted, open bucket and other types of STRONG traps. Write today.

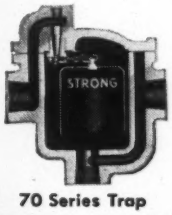
*Trade Mark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

REG. TRADE MARK — ANUM-METL Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES

Reducing Valve



70 Series Trap

Strainer

STRONG

ALDRICH HEAT-PAK OIL BURNERS

MODEL SAX

3 Models
5 Firing Ranges

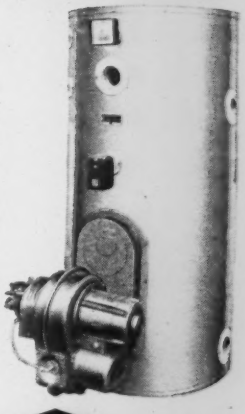
Model SAX-1 (shown above) covers .75 to 1.35 gph, SAX-2 from 1.35 to 2 gph, and SAX-3 from 2 to 4.5 gph by interchange of draft tube assemblies. Model BX covers 4 to 8.50 gph and Model JU from 7 to 19 gph for larger installations.

Featuring
ALDRICH-BUILT
Motors and Transformers

These efficient, well-built burners give reliable high performance. Made to serve all firing requirements from 3/4 to 19 gph. SAX models have interchangeable draft tube assemblies covering 3 ranges. Various length draft tubes are available, also either flange or pedestal mountings. Aldrich-built motors have continuous service-rating and transformers are radio interference-free. Burners are ideal for conversion, replacement, or original equipment.

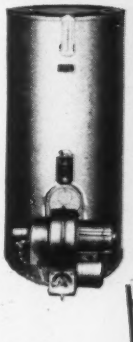
ALDRICH HEAT-PAK BOILER-BURNER UNITS

Featuring
BURNERS FOR OIL OR GAS
with Identical Ratings



These vertical fire-tube boilers are strongly built to highest standards of rugged welded construction. Give dependable, efficient performance on all types of steam or hot water heating systems. Six sizes cover capacities from 118,000 to 808,000 BTU per hour. Series B (shown) are oil-fired with Underwriters-approved Aldrich burners. Series BG are gas-fired with AGA-approved burners having ratings identical to corresponding oil burners. Both types of burners are on similar mounting plates for interchangeability. Efficient, high-delivery, double-spiral hot water coil available on specification. Many other outstanding features.

ALDRICH HEAT-PAK HOT WATER SUPPLY UNITS



Featuring
FAST HEATING and LARGE DELIVERY
No Storage Tank Required

Ideal for use in residences, apartments, clubs, factories, and many commercial and industrial establishments. Same construction and features as Boiler-Burner units above, including interchangeable firing with either oil or gas. Capacities of six standard sizes range from 125 to 850 gph of water at 100 degrees rise. Complete set of automatic and safety controls furnished. Dress shell enameled beautiful Hammerloid blue with chrome trim rings. Many other features — see literature.

Write today for current literature giving complete specifications of all Aldrich products.

SOLD THROUGH JOBBERS

Aldrich products are distributed through established plumbing and heating jobbers, and are backed by an experienced sales and service organization. Investigate the value of handling the Aldrich line! Write us, so our nearest factory representative can call on you.

ONE OF THE BREEZE MARK PRODUCTS

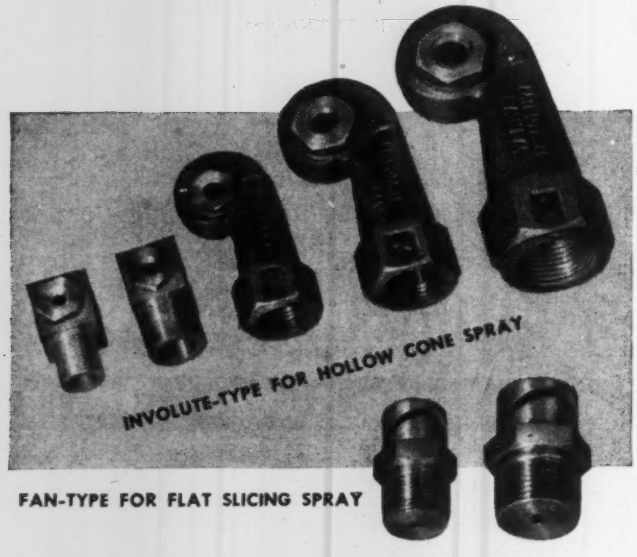
ALDRICH COMPANY, 105 WILLIAMS ST., WYOMING, ILL.

A SUBSIDIARY OF THE BREEZE CORPORATIONS, INC.

for • SPRAYING
• WASHING
• RINSING
• COOLING
• AIR CONDITIONING

YARWAY

SPRAY NOZZLES



FAN-TYPE FOR FLAT SLICING SPRAY

Get the most out of your Spraying Equipment with minimum power . . . with efficient spraying.

Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

Thousands in use. Write for Bulletin N-616.

YARNALL-WARING COMPANY
107 Mermaid Avenue Philadelphia 18, Pa.

presses, dryers, and other steam heated process equipment.

Convector Radiator

No. 6997—The Vol. 11, No. 10 issue of the house organ published by Modine Mfg. Co., Racine, Wis., is devoted to the company's new convectors which are offered in four enclosure types, are said to provide greater concealment, and are available in modular sizes. The heating unit is nonferrous and an improved method of mounting is designed to simplify installation.

Coolant Circulating Pumps

No. 6998—Foot mounted, submerged, and sidewall mounted coolant circulating pumps are covered in a new eight page bulletin (No. 52B6975) released by Allis-Chalmers Mfg. Co., Milwaukee 1. Construction details and application information are supplied for each of the eight types, together with data on dimensions, head capacity, motor frame, pipe friction, and valve and fitting flow resistance. Foot mounted pumps are made for horizontal, vertical, or oblique operations in a range of sizes up to 80 gpm and up to 100 ft. head. The sidewall mounted units range in size up to 64 gpm at heads of 70 ft.

Electric Motors, Multispeed Gearshift Drives, and Grinders

No. 6999—Lima Electric Motor Co., Lima, Ohio, has released Bulletin MB-1 describing its lines of electric motors, multispeed gearshift drives, pedestal grinders, and polishing and buffing lathes. Motors covered are designed for numerous industrial applications and the bulletin is said to be of particular interest to original equipment manufacturers as well as users.

Furnace Enclosures for Water Walled Boilers

No. 7000—Bulletin 748, issued by Geo. P. Reintjes Co., 2515-19 Jefferson St., Kansas City, Mo., covers the applications and advantages of "Floating Walls" for modern water walled boilers. Advantages are said to include the elimination of steel casings and the fact that tiles, insulation, and insulation outside finish move up and down with the tubes without excessive checking or cracking.

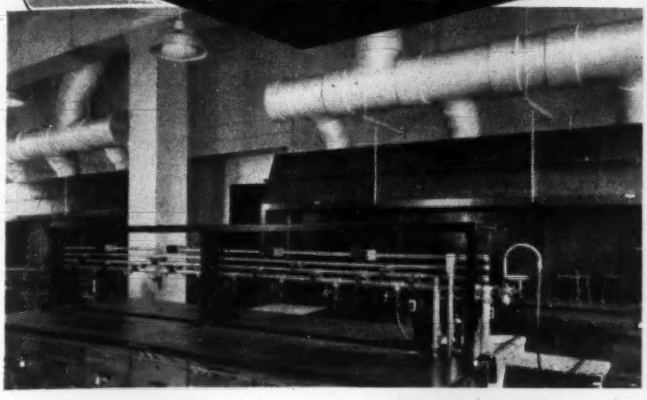
Hardfacing Alloys

No. 7001—A new booklet covering its complete line of "Airco" hardfacing alloys has been published by Air Reduction Sales Co., Dept. 1968, 60 E. 42nd St., New York 17. Each of the company's alloys is described in detail and typical uses, specifications, and data on application techniques, deposit hardness, color markings, etc., are included.

Heat Transfer Products

No. 7002—Kramer Trenton Co., Trenton 5, N. J., has issued a new price list on its line of heat transfer products described in the general refrigeration catalog No. R125. The price list, Bulletin P-170, reflects recent price increases.

NO VENTING PROBLEMS HERE...



...with Transite Industrial Vent Pipe on the job

Transite* Industrial Vent Pipe was selected for this laboratory venting system because it resists the corrosive effects of many vapors, gases, fumes . . . because it will provide effective and economical venting service for years to come.

Transite makes up into neat, efficient venting systems for a wide variety of industrial uses. As vents, ducts, stacks, this asbestos-cement pipe is quickly and economically installed . . . is light, strong and durable. It is readily workable—can be cut and drilled on the job. Rustproof, it needs no painting whether used indoors or out.

Transite Industrial Vent Pipe comes in a range of sizes up to 36" in diameter. The full line of Transite fittings meets practically any job requirement and assures a venting system which is corrosion-resistant throughout. For further details, write for Data Sheet Series DS-336. Address Johns-Manville, Box 290, New York 16, N. Y.

JOHNS MANVILLE JM PRODUCTS

Typical Industries in which Transite Industrial Vent Pipe is used:

Aircraft	Foundry	Quarrying
Automobile	Furnace	Railroad
Baking	Furniture	Rayon
Bleaching	Gas	Refrigeration
Boiler Works	Glass	Rubber
Brewing	Laboratory	Shipbuilding
Canning	Laundry	Sewage Works
Ceramic	Leather	Shoe
Chemical	Meat Packing	Smelting
Dairy	Metal	Soap
Drug	Mining	Soft Drink
Electrical	Paint	Sugar Refining
Explosive	Petroleum	Textile
Farm Machinery	Potash	Tool
Food	Pulp & Paper	Water Works

*Reg. U. S. Pat. Off.

Johns-Manville TRANSITE Industrial Vent PIPE

Profit by this great ACCESSORY Sales Opportunity

Help all your Oil Heater Customers to Oil Savings and Extra Comfort with A-P Automatic Control Accessories

How many of the nation's *4 million* oil heater owners are in your community? They're ALL ready prospects for . . .

A-P HEAT REGULATOR SETS for Thermostat Comfort Control

A-P OILIFTERS to end Oil Handling

and A-P FUEL OIL TRAP-ITS to Keep Oil Lines Clean

. . . and every one will be a mighty satisfied customer, too, when they realize the convenience and economy of AUTOMATIC CONTROL on their vaporizing oil burning appliances.

Here's powerful selling aid

for you, too... NATIONAL ADVERTISING plus COMPLETE MERCHANDISING HELPS

Direct Mail Brochures to mail to prospects.
Colorful Catalog "3 Times More Comfort."
OIL HEATER
Statement or Counter "hand-out" folders.
Tags featuring Automatic Controls are secured on every new heater control. Remind new customers of Accessories.
COMFORT Automatic
Newspaper Ad Mats covering all Accessories — for effective local newspaper "tie-in."
15-minute Slide-Sound Film for salesmen training — plus booklet "highlighting" the details.
Complete sales bulletins and service instructions.

AUTOMATIC PRODUCTS COMPANY
2460 N. THIRTY-SECOND STREET, MILWAUKEE 10, WIS.

DEPENDABLE Oil Controls
Standard on leading appliances

CASH IN . . . on new Oil Heating Accessories SALES NOW! RETURN THE COUPON TODAY!

Please send Complete "Sales Ammunition" on A-P Accessories.

Name.....
Address.....
City..... State.....
Signed by.....
Our Jobber.....

Peerless Electric

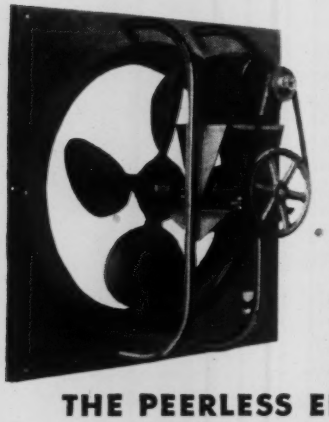
REVERSIBLE ALL-PURPOSE FAN

...A single, simple Peerless Electric plug-in PROFIT BOOSTER

UNIQUE in size and utility, this Peerless WF-30 All-Purpose, All-Metal Fan and Cabinet are 30" square and only 5½" deep . . . tremendous air capacity of 4220 C.F.M. high speed exhaust . . . low-cost operation . . . two speed ⅓ h.p. motor . . . reversible . . . exhausts day time heat or pulls in cool night air . . . thermally protected motor can't burn out.

Here's a real ready-to-plug-in appliance with dozens of commercial and domestic applications—a Peerless-quality fan that you can make a *volume* leader and a *profit* leader. Write for details TODAY!

...and a Peerless Electric easy-to-install VENTILATTIC FAN



In every community there'll be big demand for this efficient "home cooler"—*blows heat out . . . pulls cool, fresh* air in. A boon for stores, theatres, dance halls and restaurants, too. This Peerless Ventilattic Fan (dependability proved by years of satisfactory service) can be mounted at attic window by using rubber feet supplied with the unit—then easily connected to window or opening in wall with canvas boot or duct. Five sizes 24" to 42" complete with motor. *WRITE for descriptive folder and prices.*

THE PEERLESS ELECTRIC COMPANY

Member Propeller Fan Manufacturers Association • Established 1893

WARREN, OHIO

Peerless Electric
MOTORS • FANS • BLOWERS

Heavy Duty Induction Motors

No. 7003—Electric Machinery Mfg. Co., Minneapolis 13, has published new bulletins on its "Heavy-Duty" squirrel cage induction motors. Cutaway and sectional drawings show details of welded frame construction, protective design, bearings, and insulation. Bulletin 1300-PRD-190 and Bulletin 1300-PRD-189 cover two pole and four pole motors respectively. The two pole motors described are available in sizes 200 hp and larger and are recommended for boilerfeed pumps, oil pipe line pumps, centrifugal blowers, compressors, etc. The four pole motors are rated at 100 hp and larger.

High Temperature Insulation

No. 7004—Forty-Eight Insulations, Inc., Aurora, Ill., has published a 24 page catalog covering its groups of high temperature industrial insulations. Charts and illustrations cover the conductivity and installation of both plastic and block insulations. Also included are data on blanket and pipe covering types.

Industrial Motors

No. 7005—The line of industrial a-c motors offered by Howell Electric Motors Co., Howell, Mich., includes a wide range of sizes (1/6 to 150 hp) and speeds for all voltages, phases, and frequencies. Available in many types for numerous applications, they are briefly described in a new folder.

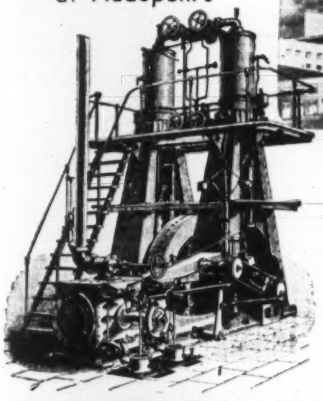
Liquid Level Measurement and Flow Meter Maintenance

No. 7006—Among the featured articles of the Vol. 3, No. 4 issue of the house organ published by Brown Instrument Div., Minneapolis-Honeywell Regulator Co., Wayne & Roberts Aves., Philadelphia 44, is a discussion of the "Gagetron" liquid level measuring instrument. This device is produced by Engineering Laboratories, Inc., Tulsa, and operates on a principle based on the radiation characteristics of the gamma rays which emanate from a minute quantity of radium salts. Connections between the inside and outside of the vessel are not used. Also included is an article on time saving hints for flow meter maintenance, by W. J. Suber. Some of the more common "tricks," based on experience, are given.

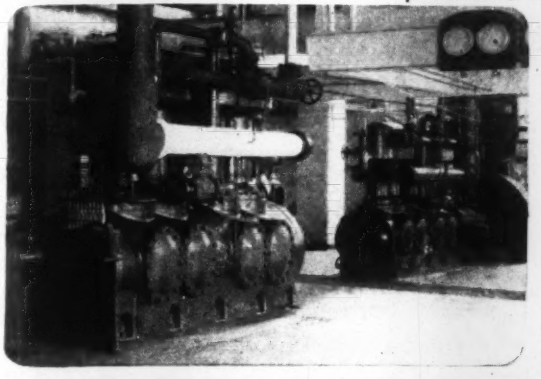
Motors for Driving Power House Auxiliaries

No. 7007—Motors of 1 hp or larger for driving power house auxiliaries are described in a 28 page illustrated bulletin (05B-5107A) released by Allis-Chalmers Mfg. Co., Milwaukee 1. The bulletin provides data on the types and characteristics of the company's induction motors, construction details of standard open type motors, special features of open type motors, and totally enclosed, fan cooled motors. Also included is a motor selection chart. According to the company, these units can be used for operating boilerfeed, condenser circulating water, and condensate pumps, as well as coal pulverizers, pulverizer exhausters, induced, forced draft and cooling tower fans, ash sluices, and coal hoists.

Below: Old and New Types of Frick Machines at Hudepohl's



Hudepohl Breweries Use FRICK Refrigeration 60 Years!



Frick ammonia compressors, as built in the Eighties and Nineties, were primitive machines by today's standards. But they were remarkably dependable: one of those installed in the Hudepohl Breweries at Cincinnati ran 57 years, another 52, two others 45!

Naturally, Hudepohls believe in Frick Refrigeration. Their fine new engine room contains the two big Frick 4-cylinder machines illustrated.

You'll get the last word in reliability when you specify Frick Refrigeration.

FRICK COMPANY Waynesboro, Penna.

---

weil "TVC" LOW RETURN CONNECTION CAST IRON RECEIVER

GUARANTEED PERFORMANCE

- *Precision-built for longer life*
- *Every pump part made and assembled in the Weil Factory*
- *Pre-tested before shipping*
- *Pump comes completely assembled*

TYPE R
Hot and Chilled Water Circulating
Ball-bearing — once a year lubrication
Capacity — 10 to 750 GPM
(write for bulletin R5500)

TYPE TR HORIZONTAL
Low and High Pressure Systems
Ball-bearing — heavy duty
Capacities to 100,000 sq. ft. E.D.R.
Pressures to 125 P.S.I.

Low return connections provide freedom of layout. Eliminates underground lines. Overhead lines may be used. Has extremely low waterline—cast iron receiver. Capacities—500 to 10,000 sq. ft. E.D.R.
(write for bulletin TVC-300)

TYPE "TVC" CONDENSATE
LOW PRESSURE SYSTEMS

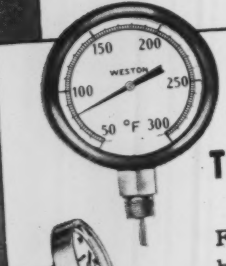
Fig. 302

weil PUMP COMPANY 1528 North Fremont Street Chicago 22, Illinois

New
HUMIDITY INDICATOR
by Weston

- **Quick-reading**
- **Convenient**
- **Accurate**

Simplified Slide Rule Calculator gives relative humidity readings directly—eliminates charts and tables. Entire unit ruggedly constructed of metal, including the two Weston dial-type thermometers, providing readings accurate to ±1% for general conditions.



WESTON
ALL-METAL
THERMOMETERS

Featuring readability, reliability and rugged construction. Available in models for industrial applications in required stem lengths and ranges; also models for laboratory use.

Available through distributors, or consult your local WESTON representative.

WESTON *Instruments*

Weston Electrical Instrument Corporation
617 Frelinghuysen Avenue, Newark 5, N. J.

Multiple Fuel Steam Generator

No. 7008—The "Powermaster" packaged steam generator is designed to burn light oil, heavy oil, or gas and is covered in a new four page bulletin (No. 1216) issued by Orr & Sembower, Inc., Reading, Pa. All units are designed around a modernized Scotch marine boiler and are built in accordance with the ASME code.

Packaged Boiler

No. 7009—"Cyclotherm" packaged heat generators of both the steam and hot water types are described and illustrated in a new six page bulletin published by Cyclotherm Corp., Dept. R7, 75 West St., New York 6. Designed for burning oil, gas, or both, units are available in sizes from 10 to 300 hp. Also stressed is the company's patented combustion system wherein high velocity air is injected at a tangent so as to form a swirling tube of air which hugs the inside of the combustion chamber.

Pressure Reducing, Relief and Regulating Valves

No. 7010—Catalog D-14, issued by A. W. Cash Valve Mfg. Corp., 666 E. Wabash Ave., Decatur, Ill., covers the company's line of pressure reducing and regulating valves for steam, air, gases, water, oil, and other liquids; small volume pressure reducing valves; refrigerant controlled water regulating valves; pipeline strainers for steam, air, gas, or liquid services; feed and relief valve combinations for hot water heating; and a variety of relief valves. Data on materials of construction, dimensions, capacities, prices, pressure ranges, etc., are included.

QUALITY *always wins!* **MARTOCELLO Products are fully DEPENDABLE**

ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, and CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their Manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost. It will pay you to consult us. WRITE or WIRE for further information.

Jos. A. Martocello & Co. 229-231 NORTH 13th STREET PHILADELPHIA 7, PA

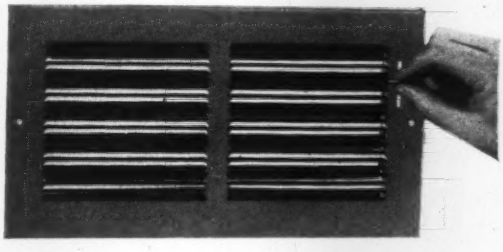
"Serving the Ice Industry Since 1916" — *"There is no Substitute for* MARTOCELLO QUALITY

You Can Get It QUICKER from STEWART

HIGH VELOCITY OUTLETS

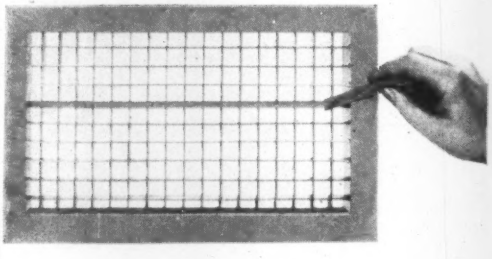
Engineered for Dependability--Flexibility

The Stewart line of high velocity outlets, scoopaires, wall and baseboard registers meet the most exacting requirements of air conditioning, heating and ventilating systems. Special types and sizes speedily produced to order —all standard equipment promptly delivered.



Style 94
Wall or Ceiling Register
Multiple Damper Lever Regulated

Size 94 is designed for wall or ceiling use, with horizontal face bars which are down deflecting. The rear bank of the Style 94 Register serves to regulate the air supply and to deflect air into the outlet. Lever operated multivalves control the degree of opening.



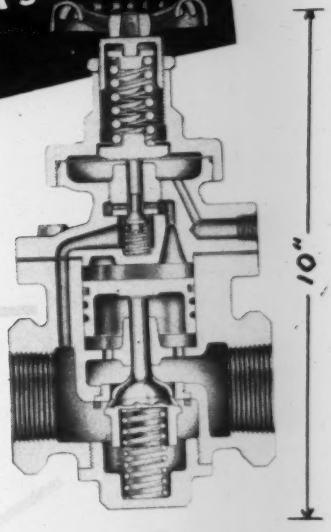
Style DDH
Double Directional 2 Banks —adjustable face and rear bars.

Style DDH Stewart High Velocity outlet with "All-Way-Selective-Air-Throw" produced by means of a removable key which can adjust any bar at various angles without affecting the setting of any other bar. Horizontal face bars and vertical bars in rear, are both adjustable for any combination of air direction desired.

Send for literature and prompt quotation on your requirements.

Stewart
MANUFACTURING COMPANY, Inc.
612 BLOOMFIELD AVE., BLOOMFIELD, N. J.

FOR CLOSE REGULATION AND COMPACT SIZE USE K&M's #481



Parabolic Inner Valve insures reliable control on all load requirements.

Single seat design for tight shut-off in dead end service.

You can remove and renew any working part without removing the valve from the line.

For rugged build, convenient size and "close tolerance" regulation of steam—you just can't beat K&M's valve type 481.

It's an internal pilot-operated pressure regulating valve, widely used in process services and marine work as a primary valve on two stage reductions.

Changes in pressure reduction are made by setting the hand wheel. For complete specification data, ask for Bulletin 1000.

The Kieley & Mueller policy of continued pioneering has helped the K&M reputation grow constantly throughout the past 69 years. Look to K&M for: BACK PRESSURE REDUCING VALVES • PRESSURE REDUCING VALVES • STRAINERS • ATMOSPHERIC RELIEF VALVES • STOP and CHECK VALVES • STEAM SEPARATORS • GREASE EXTRACTORS.

FOR ACCURACY • RUGGEDNESS
COMPACTNESS • ACCESSIBILITY
SPECIFY K&M's #481

KONTROL
MOTOR
NORTH BERGEN N.J.

Zallea Expansion Joints Rate . . .

First Choice!

THE Zallea Stainless Steel Expansion Joint shown above is one of several used in the process steam distribution line of a large Western refinery . . . installed for dependable, economical operation.

In refineries, in power plants, in chemical process plants—throughout industry—Zallea Expansion Joints are rated *first choice* as the ideal medium for absorbing movement in pipe lines due to thermal changes. These features tell why more and more engineers and designers insist on Zallea when they want the best:

- *More economical than expansion bends*—the cost of insulating and installing a bend alone is frequently more than the cost of a Zallea Expansion Joint.
- *No maintenance*—having no packing they may be used in underground lines without manholes.
- *Low thrust against anchors*—require only 1/10 the force required to compress some slip type expansion joints.
- *An expansion joint for every type of service*—special types for combined axial and lateral movement.
- *Shorter face to face dimensions*—enables installation in close quarters.
- Elements may be made of stainless steels, copper, or any other metal required.
- Hydraulic method of forming assures uniform wall thickness throughout corrugations.
- As easy to install as an ordinary flanged or welding fitting.
- Traverse range from fractions of an inch up to 7½" in a single unit and 15" in a double unit.
- Pressure range from vacuum to 300 lbs. in standard units. Up to 1000 lbs. in special units.
- Temperature range from sub-zero to 1600° F.

Catalog 47 contains complete information on all Zallea Expansion Joints. We would be pleased to send you a copy. Write today! Zallea Brothers, 816 Locust Street, Wilmington 99, Del.

Zallea

EXPANSION JOINTS

WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

Protection for Insulation

No. 7011—How insulations can be protected by "Protektite" from fire, water, and corrosives, as well as weather, is covered in a bulletin distributed by Bitucote Products Div., Bridges Paving Co., 1411 Central Industrial Dr., St. Louis 10. The protective material is an asbestos-fibrated, emulsified asphalt in mastic form. It is used to protect insulations from rain, acid fumes, fog, spray and various industrial liquids. According to the company, its tensile strength resists cracking or rupturing under normal temperature changes.

Refrigerant Suction Line Regulators

No. 7012—Suction line regulators are described in a new 20 page bulletin (No. 183) issued by Alco Valve Co., 865 Kingsland Ave., St. Louis 5. While primarily a catalog of the company's evaporator pressure regulators, it is said to contain complete sections on the proper selection, application, installation, adjustment, and servicing of these devices. It includes descriptions of various remote pilots, both pressure and temperature types, and of regulators adapted to operation from an air control system.

Refrigeration Fittings

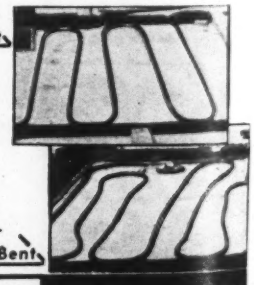
No. 7013—Electrimatic, 2100 Indiana Ave., Chicago 16, has released a refrigeration catalog (48-25) featuring its line of forged flare nuts, refrigeration fittings, and brass pipe fittings. A number of new products for the refrigeration and air conditioning industry, such as the

Announcing

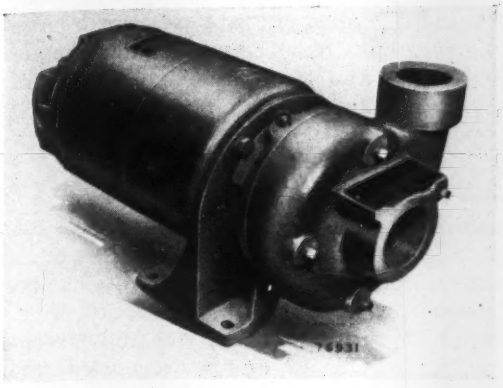
TAL Portable Tube Bender *for radiant heating*

Bend right on the spot, fast and accurately

Now, with this new light-weight machine that can be carried in one hand, you can speed-up radiant heating installations . . . for the Tal Tube Bender handles, without annealing, *hard* copper tubing as well as soft, both K and L, in all diameters from ⅜" to 1" in all standard radii. Changeovers from one size to another can be made in 40 seconds. One man does everything without help. No flattening, no kinks, no wrinkles. Made and guaranteed by Tal, the world's largest exclusive producer of pipe and tube bending equipment. Write today for data bulletin.



Tal Bender, Inc. Dept. 13 Milwaukee 2, Wis.



Horizontal
KRVS Models D & E

Vertical
KRVS Model F

COMFORT
THE YEAR AROUND

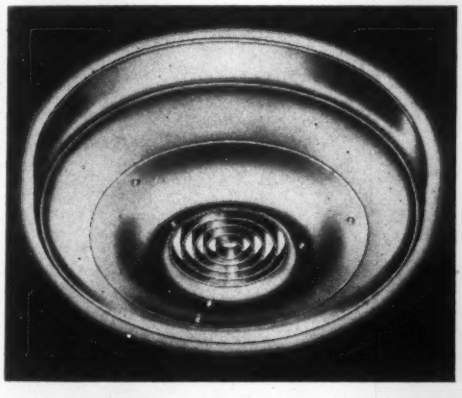
To have year-round comfort from your air conditioning or heating system, a reliable pump is a necessity. The Motorpump is such a unit. It will stay on the job.

The ¼, ⅓, ½ and 1 horsepower sizes will serve most systems; however, units up to 50 hp are included in our standard line. All are rugged and compact and easy to install. The Motorpump needs no special foundation.

Consult your nearest I-R branch office or local I-R distributor for full details. These pumps can easily be put on your present equipment or applied to your new equipment.

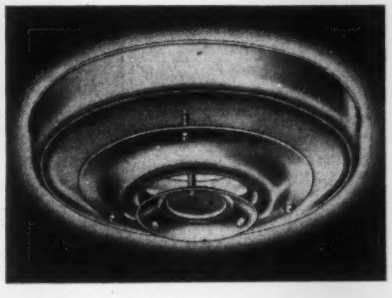
Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

91-9



Type "RE" FUSEAIR ◆
Type "SE" FUSEAIR ◆

NO DIRTY CEILINGS WITH
fuseair
CEILING OUTLETS



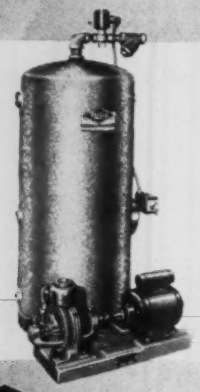
AVAILABLE FOR PROMPT DELIVERY

Write for Bulletins today

● The problem of ceiling discoloration has been effectively minimized by the development of Type "SE" FUSEAIR. The extended moulding design-feature of this unit will assure your customers a tremendous saving in redecorating costs.

ALADDIN HEATING CORPORATION
2222 SAN PABLO AVE., OAKLAND 12, CALIFORNIA

BOILER FEED AND CONDENSATE PUMPS



High pressure turbine type. Fully automatic. Simplex, Duplex and Vertical Models.

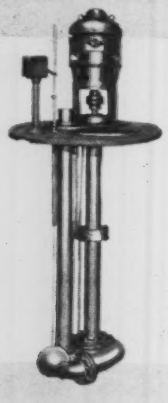
PACIFIC

DEPENDABLE

INDUSTRIAL

PUMPS

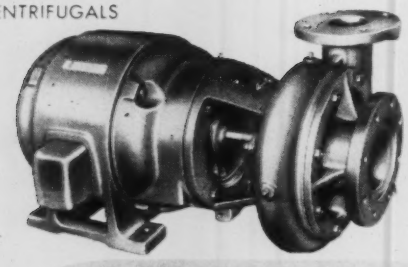
SUMP AND SEWAGE PUMPS



Heavy Duty—Modern Design—for Lifetime Service. Simplex and Duplex Models.

All over the west heating, piping and ventilating contractors depend upon Pacific for every type of industrial pump. Nearly a half century of practical experience is behind every Pacific pump.

UNITYPE AND FLEXIBLE COUPLING CENTRIFUGALS



Compact with positive rigidity. Open or enclosed impellers. Complete line designed for every industrial use.

Four Pacific Coast Offices to serve you. Our engineering staff is ready to take care of every pumping requirement. Write us today for free Pumping Manual. It's full of hydraulic tables and engineering data.

PACIFIC

PACIFIC PUMPING COMPANY EST 1907

Manufacturers and Distributors of Pumps for Every Service

SEATTLE · PORTLAND · OAKLAND · LOS ANGELES

company's new liquid indicators, are described. Also included are charging lines, quick couplers, quick coupler elbows, strainers, dryers and an oil level sight glass. Also available from the company is Catalog No. 48-2 covering automatic control and regulating valves.

Refrigeration Units

No. 7014—A 36 page catalog (No. 42) containing descriptions and data on dimensions and capacities of its line of refrigeration compressor-condenser units has recently been released by Brunner Mfg. Co., Utica, N. Y. Units are listed for use with methyl chloride and "Freon-12" and include air cooled, air and water cooled, and water cooled machines. Also shown are gasoline engine equipped units. Sizes range from ¼ to 30 hp.

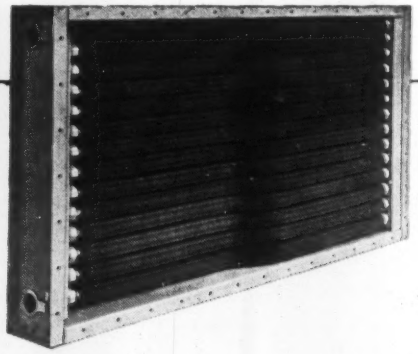
Sectional Steel Heating Boilers

No. 7015—Central States Steel Boiler Co., 4649 W. Harrison St., Chicago 44, has released a four page booklet on its line of sectional steel heating boilers which are built in accordance with the ASME code and which are designed to burn coal, oil, or gas. Of all steel welded construction, units are said to feature a low water line and low head room requirements. They may be used for hot water or steam heating and are offered in 21 sizes from 4600 to 39270 sq ft, steam rating.

Solvent for Removing Sludge from Fuel Oil Systems

No. 7016—A new pamphlet on "Houghto-Solv" has

G&O RADIATION



G&O COILS

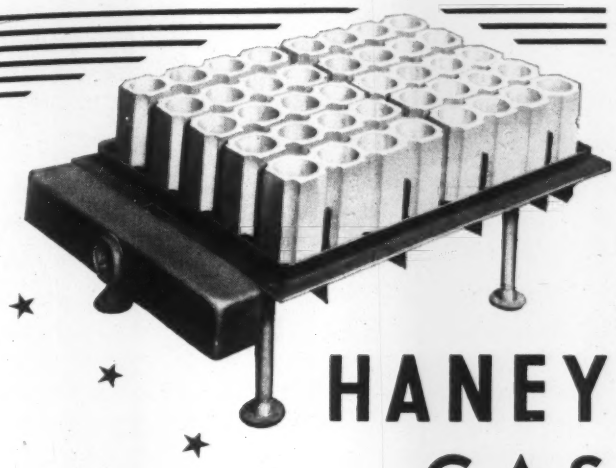
FOR HEATING AND COOLING IN A WIDE RANGE OF SIZES

Send for Catalog

THE G & O MANUFACTURING COMPANY

New Haven, Connecticut

Pioneer Manufacturers of Square Finned Tubing in the United States



HANEY GAS BURNERS

Haney Venturi Gas Burners are the answer to all your heating installations whether commercial, domestic, or industrial. The vertical type illustrated will afford economical, even, dependable heat with remarkable freedom from maintenance troubles. It's shipped completely assembled, ready for installation and is available for mixed, natural or LP gases.

We'll be glad to send more information on request . . . please write!

HANEY GAS BURNER AND ENGINEERS

909 South Myrtle Avenue — Monrovia, California

VENTILATING FANS

GB fans ● manufactured for industrial ventilating and heating ● fume extraction ● forced draft ● induced draft ● Air-conditioning ● drying and processing, are of forward or backward curved wheel design.

Type F.C. are designed for quiet operation at low speeds. Type B.C. are designed to operate at high speeds and have the non-overloading characteristics.

Capacities of 200 c.f.m. to 300,000 c.f.m. are covered by standard sizes and arrangements.

The heavier constructions of classes II, III and IV cover the particular needs of special applications.

Send for Bulletin SC-103.

GB

"LUNGS FOR INDUSTRY"

GENERAL BLOWER CO.

8610 Ferris Ave. — **Morton Grove 11, Ill.**

Engineering Offices In All Principal Cities

The BEST CONTROL BUY for INTERMITTENT OIL BURNERS

MERCOID

AUTOMATIC CONTROLS INSURE FINE PERFORMANCE AND LONG LIFE

TYPE JMI MERCOID SAFETY AND IGNITION CONTROL

"A"—Special high temperature bimetal assures constant sensitivity and long life.

"B"—The differential adjustments permit adjusting in the field to meet variations and fluctuations in stack temperatures.

"C"—Only three mercury switches used for motor, safety and ignition.

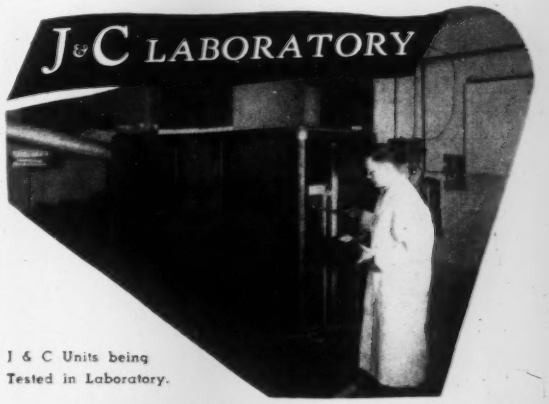
"D"—The safety timing mechanism determines the time the burner can operate without flame. It is set at the factory, but may be changed when necessary. In case of a safety shut-down, turn hand reset button to resume operation.

"E"—The Mercoid Transformer-Relay eliminates all noise and residual magnetism. It acts as its own transformer, inducing low voltage current for the thermostat circuit.

"F"—All terminals are plainly marked for correct wiring.

Write for Mercoid Catalog No. 600A

THE MERCOID CORPORATION. 4203 W. BELMONT AVE. CHICAGO 41, ILL.



J & C Units being Tested in Laboratory.

PROVES PERFORMANCE

PRECISE MEASUREMENT . . . Of exact static pressure drop across each J & C unit and proper blower size for each J & C Model.

EXHAUSTIVE TESTS . . . of J & C units provide installation engineers with the data needed for correct installations.

ONLY IN THE LABORATORY . . . may technicians definitely establish:

- Correct Pressure Loss Measurements
- Proper Temperature Rise
- Accurate Flue Gas analysis
- Known Heat Transfer

NO GUESSWORK . . . The J & C laboratory, working for you, permits accurate installations because performance capabilities are precisely determined.

THE COMPLETE LINE . . . . COMPLETELY PROVEN

J & C, America's largest and most complete Warm Air Heating Line, offers over 100 types and sizes with outputs from 3,800,000 down to 100,000 Btu in the Famous Tubular Series . . . other models down to 52,500 Btu. Exact engineering plus endless testing provide the J & C features that give you an "edge" when you specify or install J & C.

A PRODUCT OF

JACKSON & CHURCH COMPANY, SAGINAW, MICHIGAN

AIR-FLO
AUTOMATIC
CEILING SHUTTER
FOR ATTIC FAN
Built so they can be installed practically flush with the ceiling, AIR-FLO Ceiling Shutters present a refined, finished appearance. Their natural aluminum color blends with any decoration, eliminating need for painting, and no grille or winter cover is required. Furnished in 5 different widths, single panel up to 73" long. No operating mechanism shows. Built-in fusible link. Meets fire underwriters requirements.
WRITE FOR NEW CATALOG 43-D
Illustrations and details of the complete AIR-FLO line.
AIR CONDITIONING PRODUCTS CO.
2340 W. LAFAYETTE BLVD. • DETROIT 16, MICH.

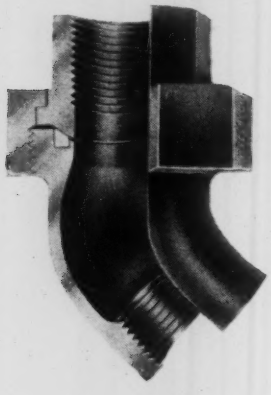
been released by E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33. The new product is described as a speedy, effective fuel oil additive for removing sludge from fuel oil systems. The folder also gives information on how to use the product, how it works, and where best to use it.

Speed Control

No. 7017—Variable speed controls, utilizing planetary motion which is applied to speed changers in combination with v belts and variable pitch sheaves, are described in a four page catalog released by Speed Selector Inc., 118 Noble Ct., Cleveland 13, Ohio. According to the company, the control will provide infinite speeds from 0 to 800 rpm and will reverse rotation where necessary.

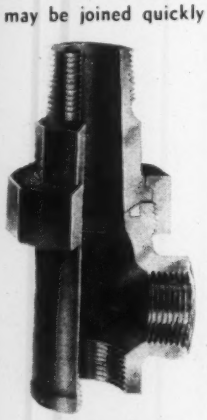
Spray Painting Equipment

No. 7018—The extensive line of equipment for spray painting, offered by Binks Mfg. Co., 3114-40 Carroll Ave., Chicago 12, Ill., is illustrated in a new folder. Equipment includes a variety of spray guns, compressors, oil and water extractors, exhaust fans, hose, pressure and siphon tanks, turntables, and numerous accessories. A new price list (No. 901) has recently been issued and covers equipment listed in Catalogs Nos. 97 and 953. With but few exceptions, the new prices reflect an increase of approximately 10 percent.



JEFFERSON
SPECIALTY
UNIONS
make better piping installations possible

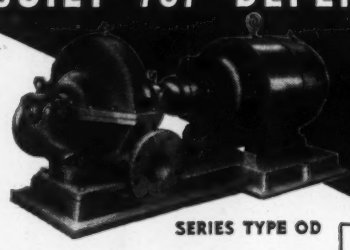
Jefferson Unions are easy to work with. That's been proven time and time again on countless intricate piping installations where the fittings must go in the first time RIGHT! These unions may be joined quickly and easily and because of the exclusive recessed brass seat joints may be broken, if necessary, many times without affecting their sealing qualities. The recessed brass seat can't be dislodged by pipe ends screwed in too far, either . . . it's made to stay put, thus you're assured of a permanent leak-proof joint every time.



Please write us today for more information

JEFFERSON UNION CO.
607 West 26th Street, New York 1, N. Y.
35 Fletcher Avenue, Lexington 73, Mass.
65 Gooding Street, Lockport, N. Y.

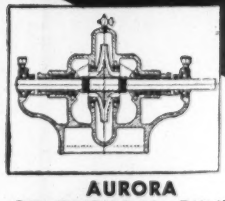
BUILT for DEPENDABILITY



AURORA HORIZONTALLY SPLIT CASE DOUBLE SUCTION SINGLE STAGE CENTRIFUGAL PUMPS "by Aurora"

SERIES TYPE OD

The ultimate in design and perfection — type OD pumps — in capacities to 4,000 G.P.M. and heads to 300 ft. — are accessible, compact and lasting. They are widely used for general water supply, for municipalities, industrial buildings and institutions. Also for handling condenser circulating water, liquids in paper mills and distilleries, chemical solutions, oil in oil fields and refineries, irrigation, etc.



AURORA CENTRIFUGAL PUMPS — are also available in HORIZONTALLY SPLIT CASE TWO STAGE DOUBLE SUCTION • SIDE SUCTION • VERTICAL • NON CLOG • SUMP • MIXED FLOW • DEEP WELL TURBINES • and SPECIAL DESIGN.

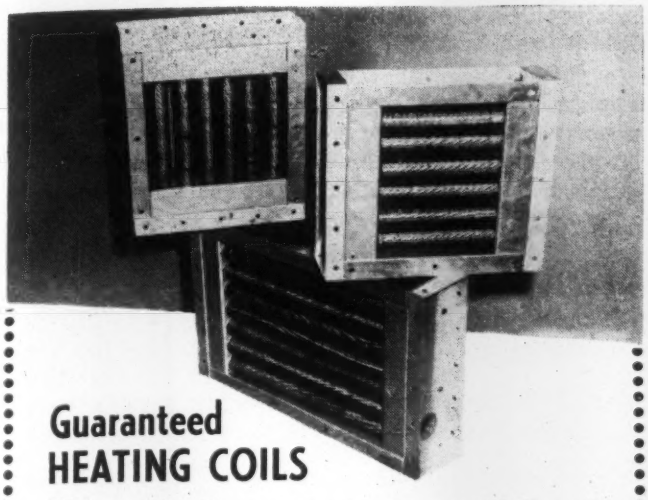
Write for CONDENSED CATALOG "M" or CONSULT SWEETS

APCO TURBINE-TYPE PUMPS

Here's the Pump for "1001" duties. SIMPLE — only one moving part, the impeller. Capacities to 150 G.P.M., Heads to 600 Ft., Slight change in capacity against drastic head variations.

DISTRIBUTORS IN PRINCIPAL CITIES

AURORA Always PUMPS
AURORA PUMP COMPANY
80 Loucks Street, AURORA, ILLINOIS



Guaranteed HEATING COILS

Efficient and stable at steam pressures up to 200 lbs. All expansion stresses are taken up in the heating section itself. No brazing or welding in assembly. Encased coils standard equipment ready for installation in any position or stacking arrangement.

Widths 8¾" to 34". Tube lengths up to 120". Coils furnished with or without casing.

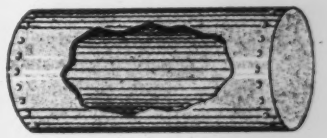
Copper Tubes and Fin with Cast Iron Headers. All coils inspected for workmanship and tested hydrostatically at minimum of 300 PSI. Tube within a tube to prevent freezing when required. Fins 6-7-and 8 per inch.

IMMEDIATE DELIVERY—*Write for Bulletin 147*

CHICAGO FAN & FIN COIL CO.

1937 W. Walnut St., Dept. A Chicago 12, Ill.

NEW LIFE!



to Old Water Tanks

WITH APEX PERMANENT PORCELAIN LINING. Pitted or leaky water tanks can be restored to original usefulness by relining, applied in two coats approximately ¼" thick—cures under water—has an affinity for lime—prevents corrosive and pitting action on metal—withstands temperatures up to 250° without cracking—adds years to life of tank.

RID-AL SERVICE CLEANS

CHEMICALLY STEAM & WATER SYSTEMS. Eliminate sludge and foreign matter from your entire plant safely and economically. We clean and restore to original operating efficiency CHEMICALLY such equipment as: TURBINES — CONDENSERS — STEAM FEED LINES — CONDENSATE RETURNS —WATER HEATERS—STEAM KETTLES—COOLING AND HEATING COILS — PREHEATERS — HEAT EXCHANGERS — EVAPORATORS — TRAPS OF ALL KINDS — ETC.

Consultation Service—Without Obligation

APEX Engineering Company

CEntral 6-2909

75 E. WACKER DRIVE CHICAGO, ILL.

Positive Protection

BUILT-IN at FACTORY

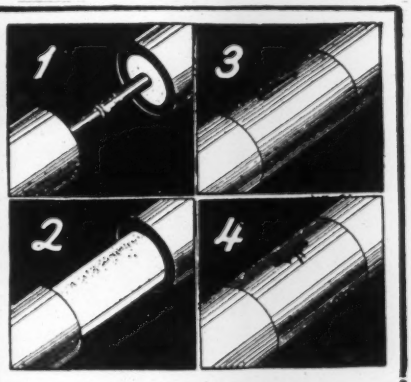
For all your underground and exposed piping jobs you'll like DURANT Pre-Sealed Insulated Pipe. It is waterproof . . . reduces installation costs to a minimum . . . eliminates electrolysis and corrosion . . . requires very little trenching and field work . . . avoids extra cost of waste and breakage . . . comes to you ready to install. In short, D.I.P. is the *perfect pipe* for this type of job. Investgate D.I.P.! Write for details today.

SEE OUR EXHIBIT AT NEW YORK POWER SHOW

Durant INSULATED PIPE CO.

1015 Runnymede St.

Palo Alto, Calif.



4 Simple Steps

1. Field joint ready for inspection. 2. Joint covered with standard pipe insulation. 3. Durant joint casing in place ready for asphalt. 4. Asphalt poured in slot making a perfect seal.

Ready to Install

PRE SEALED

FOR STEAM HOT WATER REFRIGERATION

Trade Mark

Reg. U.S. Pat. Off.

D.I.P.

The ORIGINAL Pre-sealed Insulated Pipe

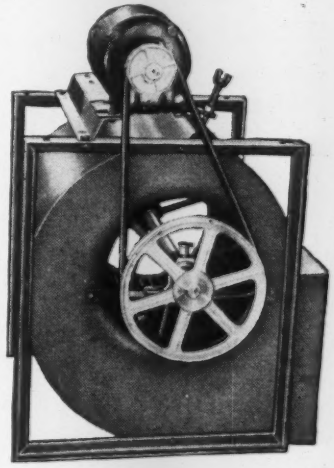
THE

NEW

UNIVERSAL

TYPE "N"

BLOWER



MASSACHUSETTS . .

By changing the position of the oil cup, the four popular discharges (lower horizontal, upper horizontal, down-blast and up-blast) can be obtained. Sizes 7 to 16½ inches wheel diameter.

WRITE FOR BULLETIN No. 110 CATALOG

MASSACHUSETTS BLOWER DIVISION

The BISHOP & BABCOCK Mfg. Co.

4901 HAMILTON AVENUE CLEVELAND 14, OHIO

SIMPLIFIED
Stainless
FABRICATION
with P. P. & E. STAINLESS
WELDING FITTINGS
1
CUT STAINLESS PIPE OR TUBING TO DESIRED LENGTHS
2
BUTT WELD P. P. & E. STAINLESS WELDING FITTINGS
Any stainless steel piping system can be constructed with a minimum of equipment, using P. P. & E. stainless steel welding fittings, simply by straight cutting of tubes to desired lengths and plain butt welding. Fitting and welding time is thereby reduced, and a cleaner, lastingly efficient system is assured, since pockets and sharp corners that cause pressure drop are eliminated.
P. P. & E. stainless welding fittings are made in Stainless Types 304, 316, and 347, to match pipe and tubing of various wall thicknesses in sizes from 3/4" through 12". Send for Catalog S-309 which gives complete specifications and list prices of the world's most complete line of stainless steel welding fittings.
STAINLESS ALLOY DIVISION
PITTSBURGH PIPING and EQUIPMENT COMPANY
10 43rd Street · Pittsburgh, Penna.
World's Largest Manufacturer of Stainless Steel Welding Fittings

Stainless Steel Valves, Fittings, and Accessories

No. 7019—Cooper Alloy Foundry Co., Hillside 5, N. J., has published an 80 page catalog (No. 51) giving concise information on its line of stainless steel valves, fittings, and accessories. A tab indexing system facilitates the finding of data on dimensions, finished weights, prices, etc.

Steam Heating Specialties

No. 7020—"Equalizing" steam radiator valves, vent valves, and air eliminators are used in the vaporizing and equalizing system of the Gorton Heating Corp., Cranford, N. J. Bulletin No. 116 describes these specialties which are designed to permit uniform heating at 4 to 8 oz pressure in automatic steam heating systems.

Sump Pump

No. 7021—The sump pump developed by Jacuzzi Brothers, Inc., 1450 San Pablo Ave., Berkeley 2, Calif., consists of a bronze pump connected to an electric motor by a vertical impeller shaft; the motor switch being actuated by a copper float. The unit is described and illustrated in a new folder.

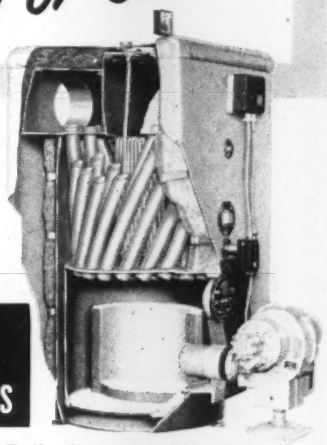
Synchronous Motors

No. 7022—New bulletins are now available on the bracket and pedestal bearing types of synchronous motors offered by Electric Machinery Mfg. Co., Minneapolis

Automatic
REZNOR
GAS FIRED
UNIT HEATERS
QUICKLY, EASILY INSTALLED
The "Automatic" Reznor unit is a complete, dynamic package of heat production that can be installed with a minimum of time, expense and inconvenience . . . its saleability is tremendous. Obstacles to modernization are removed—no interruption to work schedules, no extensive contractor muss and cost.
REZNOR UNITS PREFERRED
Reznor leads in gas fired unit heater sales because dependability has been established, efficiency of the heat exchanger has been proven, and because of the more effective distribution of heat by the BIG, QUIET FAN. The construction is durable. Hanger rods of the suspended model carry the load—the cabinet doesn't support the weight. You can sell Reznor units with confidence in quality and performance. Write for details.
SUSPENDED OR FLOOR MODEL
REZNOR
Gas fired unit heaters
A SIZE FOR EVERY NEED
REZNOR CO. MERCER 8, PENNA.
GAS FIRED HEATERS SINCE 1888
NO BOILERS • NO STEAM LINES
NO FUEL STORAGE • NO FIRE TENDING

We Invite You
TO TEST NICHOLSON STEAM TRAPS FOR
LOWEST STEAM LOSS
LARGEST CAPACITY
See why an increasing number of America's leading plants are standardizing on Nicholson traps.
Comparative tests by large trap users show: record low for steam waste; 2 to 6 times average drainage capacity; operate on lowest temperature differential; no freeze-ups; greater simplicity (fewer spare parts). 5 types for every purpose; size 1/4" to 2"; press. to 225 lbs.
Test trap gladly sent. BULLETIN 1047.
W. H. NICHOLSON & CO. 198 OREGON STREET WILKES-BARRE, PA.
Valves • Traps • Steam Specialties

Finer Performance with Oil or Gas



ASME CONSTRUCTION

EXCLUSIVE SPIRAL TUBES

Mt Hawley BOILER-BURNER UNITS

104,000 to 1,043,000 BTU Boiler-burner units, gas or oil-fired. Exclusive Spiral Tube design extracts more heat, reduces stack temperature by 100°. 7 sizes—3 domestic; 4 commercial. Shipped assembled, just remove crate. Easy to install. All sizes available galvanized for water heating. Write for literature.

MT. HAWLEY MFG. COMPANY

1, Mt. Hawley Airport, Peoria, Illinois

Manufacturers of a complete line of conversion oil burners—0.65 to 20 G.P.H.

Continuous and Reliable HEAT!

CHROMALOX Electric AIR-BLAST HEATERS

IN AIR DUCTS FOR DRYING OVENS, SPACE HEATING, ETC.

·ECONOMICAL ·EASY TO INSTALL

CHROMALOX Air-Blast Units are a reliable heat-source in air ducts for heating air under forced circulation. Banks of Fin-strip Heaters deliver more heat in a given area. Fins dissipate heat faster, permitting lower operating temperatures.

Standard CHROMALOX Air-Blast Heaters are available in seven sizes with capacities from 5-KW to 40-KW.

FOR IDEAS . . .

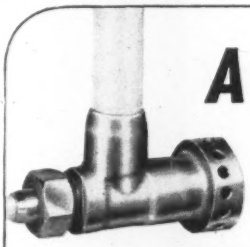
Write for "100 Ways To Apply Electric Heat" booklet and data-packed Catalog 42.

EDWIN L. WIEGAND CO., 7610 THOMAS BLVD., PITTSBURGH 8, PA.

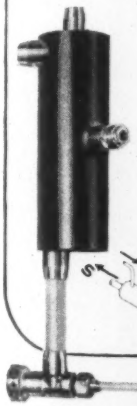
CHROMALOX 18-44

ELECTRIC HEAT FOR MODERN INDUSTRY

Automatic Liquid Feed without Moving Parts



Injector with Distributor Head

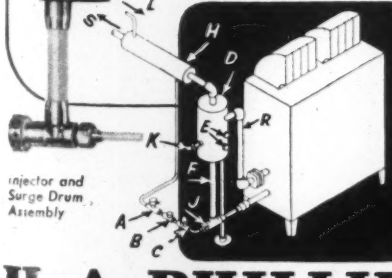


THE PHILLIPS INJECTOR provides completely automatic evaporator feed with *no moving parts*. By supplying recirculated liquid steadily to the evaporator it increases heat transfer and increases the evaporator capacity.

Many existing dry-expansion evaporators can be easily changed to Injector operation, with improved performance assured.

Adaptable to "Freon" applications, from air conditioning and water chilling to cold storage installations with plate coils, fin coils, and unit coolers. Injector capacities from fractional to 200 tons with "Freon". Furnished with either single outlet or distributor head.

Write for sketches showing typical Injector installations.



Injector and Surge Drum Assembly

FLOOR TYPE ROOM COOLER HOOK-UP

A—MAGNETIC SOLENOID
B—BULLS-EYE
C—HAND VALVE
D—SURGE DRUM
E—SIGHT GLASSES
F—LIQUID LEG
H—HEAT EXCHANGER
J—INJECTOR
K—CHARGING CONNECTION
L—LIQUID LINE
R—GAS RETURN
S—SUCTION LINE

H. A. PHILLIPS & CO.

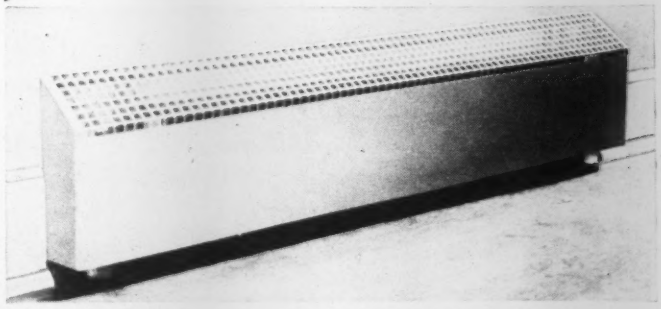
3255 WEST CARROLL AVENUE • CHICAGO 24, ILLINOIS

GREATER B.T.U. OUTPUT!

• Prompt Delivery •

REMPE AIR GUIDE **CONVECTORS**

Wall panel type



HEAT TRANSFER EQUIPMENT REMPE CO. Founded 1890

FOR INSTALLATION ABOVE OR IN BASEBOARD FOR STEAM OR HOT WATER

An attractive, easy to install Fin Tube Convector for new installations or replacement of cast iron radiators. Strong slanted steel cover.

Rempe method of using 3/16" collar into which tubes are expanded provides more efficient heat transfer—greater B.T.U. capacity per lineal foot. E.D.R. capacity 4.75 sq. ft. per lineal foot of casing length. 8" high x 3" deep. Lengths up to 116".

Write today for prices—Territories open.

REMPE CO.

342 N. SACRAMENTO BLVD. CHICAGO 12, ILLINOIS